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WASHINGTON STATE DEPARTMENT OF ECOLOGY

TACOMA CENTRAL WASTEWATER TREATMENT PLANT CLASS II INSPECTION JUNE 26-28, 1989

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ABSTRACT

A Class II inspection was conducted on June 26-28, 1989, at the Tacoma Central Wastewater Treatment Plant. The effluent was within permit limitations during the inspection. Copper and cyanide in the effluent exceeded acute water quality criteria for saltwater. Ammonia exceeded chronic criteria for saltwater. Effluent bioassay test results showed moderate acute toxicity to Microtox, moderate chronic toxicity to fathead minnow, and significant chronic toxicity to echinoderm. A recent upgrade to secondary treatment has resulted in a major reduction in the loading of Biochemical Oxygen Demand (BOD_5), Total Suspended Solids (TSS), and fecal coliform bacteria to the receiving water. The current quality of water in the Puyallup River, following a recent relocation of the WTP outfall from the river to Commencement Bay, is compared to that shown in earlier studies.

INTRODUCTION

A Class II inspection was conducted on June 26-28, 1989, at the Tacoma Central Wastewater Treatment Plant (WTP). Conducting the inspection were Carlos Ruiz, Pat Hallinan, Marc Heffner and Keith Seiders from the Department of Ecology (Ecology) Compliance Monitoring Section. Dave Hufford, Tacoma Central plant manager provided assistance. The plant was recently upgraded from a primary treatment to a high purity oxygen secondary treatment facility. As part of the upgrade, the outfall was relocated from the Puyallup River to Commencement Bay.

Objectives of the survey included:

1. Verify compliance with permit parameters.
2. Characterize the WTP influent, effluent, and sludge chemically to identify toxic pollutants.
3. Assess the toxic effect of whole effluent and sediments surrounding the outfall using bioassays.
4. Characterize any changes in the Puyallup River at high slack tide in the area of the old discharge following the relocation of the WTP outfall to Commencement Bay.
5. Characterize any changes in the WTP performance following the upgrade.
6. Assess the permittee's self-monitoring by reviewing laboratory, sampling, and flow measurement procedures.

LOCATION AND DESCRIPTION

The Tacoma Central (#1) WTP is located on the south side of the Puyallup River at approximately river mile 1.6 (see Figure 1). The original plant was completed in 1952. Upgrading and renovation of the original primary treatment plant was completed in 1982 and construction of a high purity oxygen secondary treatment facility was completed in 1989. The plant serves a major portion of the City of Tacoma (pop. 162,000), including the business district and the industrial port area. In addition, treatment and disposal services are provided to the Towns of Fife, Fircrest, Milton, and various portions of Pierce County. The City of Tacoma has an industrial pretreatment program. This allows for the reduction, elimination, or alteration of pollutants in industrial wastewater prior to discharge into the Tacoma sewer system.

A schematic of the plant is shown in Figure 2. Raw wastewater flows through coarse screens to the influent wet well where it is pumped to the grit removal facility. Flow is measured by a magnetic flow meter on the discharge pipe from the influent wet well.

The wastewater then flows by gravity to four rectangular primary clarifiers operated in parallel. Primary effluent flows to the oxygenation tanks and then to the final settling tanks. The treated effluent is chlorinated, then sent through a three-mile long, 60-inch force main which also serves as a chlorine contact chamber. The effluent is discharged through a 300-foot long diffuser located 1240 feet offshore in Commencement Bay at an approximate depth of 120 feet (Figure 1).

Raw sludge from the primary clarifiers and thickened sludge from the final settling tanks is aerobically and anaerobically digested, then dewatered by belt filter press. The stabilized sludge is transported off-site for use as a soil conditioner.

The Tacoma Central plant is currently discharging under NPDES Permit No. WA-003708-7. This permit expires March 11, 1990.

METHODS

A complete listing of sampling times, stations, and parameters is given in Tables 1a and 1b. Sampling locations are noted in Figures 2 and 3.

Ecology collected influent samples at two locations. A composite and one grab sample were collected at the influent headworks, upstream of the in-plant return lines, for conventional and priority pollutant analysis.

Ecology collected a composite and three grab samples, and Tacoma collected a composite sample from the grit chamber influent channel, below the return point for in-plant sidestreams. The composites collected here by Tacoma and Ecology were split for analysis by each laboratory. Ecology performed conventional pollutant analysis on both split samples.

Ecology collected composite and grab samples, and Tacoma collected an effluent composite sample at the effluent pump station. The composite samples were split for analysis by each lab. Ecology analyzed the samples for conventional pollutants.

Ecology collected final chlorinated effluent samples for conventional and priority pollutant analysis (grab and composite) and fecal coliform (grab) at the sample access hut above the marine outfall at Commencement Bay. A three-part manually composited sample for bioassay analyses was collected concurrently with the grabs. Acute bioassays were conducted on trout, *Daphnia pulex*, and Microtox. Chronic bioassays were conducted on fathead minnow and echinoderm.

A composite and two grab samples of primary effluent (from the primary clarifiers) were collected and a grab sample was taken at the activated sludge (oxygenation) tanks for selected conventional pollutant analysis.

All composite samples described above (with the exception of the manual composite for the bioassay analyses) were collected with ISCO automatic samplers. The sample collection jugs were iced to cool samples as they were collected. The sampling scheme for each was as follows:

Influent (head works)	360 mL every 30 minutes for 24 hours
Influent (grit chamber)	210 mL every 30 minutes for 24 hours
Effluent (pump station)	300 mL every 30 minutes for 24 hours
Effluent (outfall)	360 mL every 30 minutes for 24 hours
Primary clarifiers	270 mL every 30 minutes for 24 hours

Composite samplers were specially cleaned prior to the inspection using the priority pollutant cleaning protocol contained in Appendix A.

A sludge sample was collected from the belt press at the sludge dewatering facility for BNA, pesticide, PCB, priority pollutant metals, and EP toxicity metals analysis.

Grab composite samples of Puyallup River water were collected from the river mouth on Commencement Bay and from a point approximately ten meters above the former discharge point of the WTP. The samples were collected during high slack tide in order to compare the results to samples obtained under similar conditions in a 1981 study. Samples were taken from a depth of approximately one meter at the former discharge point and from the top ten centimeters at the river mouth. These samples were analyzed for conventional and priority pollutants, fecal coliform, and were used for an acute trout bioassay.

Sediment samples were collected at these sites in the river as well as in the area of the current marine outfall location in Commencement Bay (Figure 3). River samples were collected with an Eckman pipe dredge sampler. Marine samples were collected with a $0.1m^2$ van Veen grab sampler following Puget Sound Protocols (Tetra Tech, 1986). Sample A was collected 100-150 feet beyond the end of the diffuser and 30-50 feet perpendicular to it. Sample B was collected 250 yards from shore and 130 yards from the buoy marking the end of the diffuser. A background sample (sample C) was collected 300 yards offshore and 145 yards perpendicular to the dock at Pier No. 23 in Commencement Bay. Priority pollutant analyses were conducted on all sediments. *Rhepoxynius abronius* bioassays were performed on the marine sediments.

Ecology's analytical methods used are listed in Table 2, along with the laboratory performing the analysis.

RESULTS

Ecology's general chemistry results are summarized in Tables 3a and 3b.

Comparison of Inspection Results to NPDES Permit Limits

A comparison of effluent analytical results to NPDES permit limits is given in Table 4. Ecology did not collect flow data during the inspection. The value of 19.5 MGD was provided by Tacoma from their flow monitoring records. BOD_5 (Biochemical Oxygen Demand - 5 day), TSS (Total Suspended Solids), and fecal coliform counts were well under permitted limits. The pH was within the required range. BOD_5 and TSS removal efficiencies were 96 percent and 99 percent, respectively, based on the headworks and marine outfall composite analyses.

Plant loading during the inspection was well below the design criteria (Table 5).

Influent and Effluent Chemistry

The complete influent and effluent analyses for priority pollutant organics and metals is contained in Appendix B. Table 6 lists the priority pollutants found at detectable levels along with water quality criteria, if applicable.

Organics

The plant influent was analyzed for BNAs, pesticides, PCBs and volatile organics. The only organics found in the influent were a number of volatiles detected at low levels. The only organic found in the plant effluent was chloroform at 5 ug/L, indicating that the volatile organics are being removed in the treatment process.

Metals

Copper was present in the effluent at a concentration of 13 ug/L which exceeds the acute water quality criteria of 2.9 ug/L for saltwater (EPA, 1986). All other metals found at detectable levels were below the acute and chronic criteria established for saltwater. With the exception of arsenic, effluent metal concentrations were roughly 10-25 times less than influent in those cases where ratios could be calculated. The arsenic concentration remained constant.

Cyanide

Cyanide was present in the effluent at a concentration of 8 ug/L. This exceeds the acute and chronic criteria of 1.0 ug/L established for saltwater (EPA, 1986).

Sludge Chemistry

Sludge was analyzed for BNAs, pesticides, PCBs, priority pollutant metals and EP toxicity metals. The results are contained in Appendix B.

Organic analysis of the sludge resulted in the detection of 250 mg/Kg (dry weight) of bis(2-ethylhexyl)phthalate, a chemical used in plastics manufacturing. The Environmental Protection Agency (EPA) has not proposed a numerical limit for this pollutant if it is to be disposed of by land application, distributed and marketed, or incinerated. A limit of 782 mg/kg (dry weight) has been proposed for surface disposal sites (EPA, 1989). Sludge metals concentrations (total), proposed EPA limits for non-agricultural land application (defined as land on which neither food nor animal feed crops are grown), and data from previous inspections of other activated sludge plants are presented in Table 7. All metals are under the proposed maximum concentration for non-agricultural land application. The results are within the range of previous inspections statewide and, with the exception of relatively high copper, are in good agreement with the mean value obtained from 34 previous inspections.

An Extraction Procedure (EP) toxicity analysis of the sludge for metals, designed to simulate the leaching of the sludge in a sanitary landfill, showed all of the EP toxicity metals to be well under the Dangerous Waste designation concentrations (Table 7).

Effluent Bioassay

Effluent acute bioassays were conducted using trout, Microtox, and *Daphnia pulex*. Chronic bioassays were conducted on fathead minnow and echinoderm (sand dollar). The results of these tests are summarized in Table 8. Chronic bioassay data is included in Appendix C.

The effluent produced little or no acute toxic response in trout or *Daphnia pulex* which had survivals of 90% and 100%, respectively, in 100% effluent. Moderate toxicity was observed in the Microtox bioassay (acute) and the fathead minnow bioassay (acute and chronic).

The echinoderm (sand dollar) sperm cell bioassay results indicated significant toxicity in the effluent. Effluent toxicity was based on the success of fertilization after sperm were exposed to dilutions of the effluent in clean seawater for 30 minutes. Toxic effects were observed at 0.1% effluent in clean seawater, the lowest concentration tested (LOEC = 0.1%, NOEC $<$0.1%). The EC_{50} (the concentration of effluent in seawater at which 50% of the eggs were unfertilized) was 3.2%. Salinity checks using clean seawater and distilled water in place of effluent resulted in a LOEC, NOEC and EC_{50} of 6%, 12%, and 31% respectively. It is unlikely that salinity was an important factor in the toxicity observed in this test (M. Stinson, personal communication).

The effluent toxicity could be due to un-ionized ammonia. The water quality criteria established for ammonia are pH and temperature dependant. The freshwater bioassays were conducted under pH and temperature conditions which would cause the chronic water quality criteria for ammonia to be exceeded at all times (EPA, 1986 and Table 9). The acute freshwater criteria were exceeded at times (as the pH increased) during the trout, fathead minnow, and *Daphnia pulex* bioassays. The chronic saltwater criteria for ammonia was exceeded during the echinoderm bioassay (EPA, 1989b).

Copper and cyanide were also present at levels exceeding water quality criteria for fresh and saltwater and could have caused toxicity (Table 6).

Sediment Chemistry - Commencement Bay

The results of the priority pollutant analysis of marine sediments are given in Appendix B.

Sediment chemistry is compared with Ecology's criteria in Table 10. Phenol was found in the background sample at an estimated concentration above the sediment criteria (Betts, 1989). No other sediment criteria were exceeded in any of the Commencement Bay sediment samples.

Sediment Bioassay - Commencement Bay

Results of the amphipod bioassay are given in Table 8. Mortality and avoidance among samplers were similar to the laboratory control with the exception of the background sample which showed a small, but statistically significant, increase in mortality over the control (Dunnett's t-test, $p \leq 0.05$). The percentage of amphipods able to rebury after the ten-day exposure period was 100 percent for all samples, which suggests no sub-lethal effects.

Puyallup River Chemistry and Bioassay

Ecology conducted a survey of the Tacoma Central WTP receiving water in 1981 (Johnson and Prescott, 1982). At the time of this survey, the WTP was discharging primary effluent into the Puyallup River.

The lower reaches of the river are tidally influenced with the saltwater wedge from Commencement Bay sometimes penetrating upstream beyond the former WTP outfall. Johnson and Prescott observed that flood tides caused stagnation and pooling of the WTP effluent for several hours at the outfall when river flows of 1790 cfs (or less) occurred in conjunction with tide heights in excess of 11 feet. The water quality, in the area of the pooled effluent, was well below that in the effluent plume during free downstream flow. Based on conventional parameters (dissolved oxygen, conductivity, oxygen demand, ammonia, phosphate, and oil/grease), the area of pooling was shown to contain up to 35 percent WTP effluent during high slack tide.

In 1981, water samples were collected in the Puyallup River from an area just above the WTP discharge site (Site 2). Samples were collected during high slack tide and during ebb tide. During high slack tide, the sampling site was within the area of the pooled WTP effluent. A sample was also collected in the area of the river mouth on Commencement Bay (Site 5).

An attempt was made to collect samples under the same conditions in 1989. However, river flow during the 1989 inspection was 2610 cfs (Puyallup River at Meridian Street Bridge) and tide height was 9.5 feet. Slack water conditions were not observed at Site 2 during high slack tide.

In another study, the U.S. Geological Survey (USGS) reported on a 1984 water quality survey in the lower Puyallup River (Ebbert, *et al.*, 1987). Samples were collected at the river mouth (Site 5) and at Lincoln Avenue (Site 4) in Tacoma. The USGS report indicated that the freshwater acute and/or chronic criteria for five metals (zinc, cadmium, lead, copper, and mercury) were being exceeded in the lower river.

Analytical results from the 1981, 1984, and 1989 surveys are presented in Table 11. The sampling sites indicated are shown on Figure 3.

Based on the USGS data, the lower Puyallup River was placed on the "short list" of waterbodies as required by Section 304(1) of the Federal Clean Water Act of 1987. The "short list" contains waterbodies which are not expected to meet all applicable standards for certain toxic pollutants due substantially to point source discharges after current technology-based control requirements have been met. The subsequent deletion of the lower Puyallup River from the "short list" in 1989 was based in part on the diversion of the WTP outfall to Commencement Bay.

In 1989, mercury was undetected at 0.1 ug/L at the river mouth and was found at 0.1 ug/L above the old discharge site. The detection level exceeds the water quality chronic criteria for mercury in freshwater (0.012 ug/L). Cadmium, undetected at both stations, and lead, undetected at the old discharge site, had detection levels which exceeded acute and/or chronic water quality criteria. All other priority pollutant metals concentrations were below acute and chronic water quality criteria in 1989.

Of the five metals which resulted in the 304 (l) "short listing" of the lower Puyallup, zinc, copper and perhaps lead concentrations were lower in the former receiving water environment during the 1989 survey following the relocation of the WTP outfall than during the previous surveys. Cadmium and mercury detection levels were not low enough to provide information on improvement.

Arochlor 1242, a PCB, was found at 2.2 ug/L in 1989 at the old discharge site. This exceeds both the acute and chronic criteria for freshwater. The source of this contaminant is unknown. Acetone and methylene chloride (the solvents used in cleaning the sampling equipment) were detected at low levels in both 1989 samples. No other priority pollutant organics were found above detection levels in the river in 1989 (Appendix B). Priority pollutants found in 1981 and 1984 were in concentrations below the 1989 detection levels with the exception of phenol. Phenol was found at 80 ug/L at the outfall in the 1981 high slack tide sample, but was undetected (< 10 ug/L) in 1989.

River sediment samples were collected roughly 1800 feet above and 600 feet below the former outfall in 1981, and 30 feet above the outfall in 1989. Sediments were also collected in the area of the river mouth in 1981 and 1989 (Figure 3). The sediments collected in 1989 near the former discharge generally showed lower concentrations of heavy metals, with the exception of chromium and zinc, than the 1981 samples collected above and below the discharge point. Conversely, the sediment samples taken from the mouth of the river had generally higher concentrations of heavy metals in 1989 than in 1981 (arsenic and mercury were slightly lower in 1989). Grain size analysis of 1989 sediments is included in Appendix D.

Performance of WTP Following Upgrade to Secondary Treatment

On August 25-26, 1981, and February 16-17, 1982, Ecology conducted Class II inspections at the Tacoma Central Plant. During this period the primary treatment facility was undergoing renovation. The inspections showed the plant to be in violation of several permit requirements for effluent BOD_5 and TSS concentration and loading.

Table 13 compares the final effluent analysis from the 1981-82 inspections with the primary and final effluent analysis from 1989. The 1989 results show that primary effluent BOD_5 and TSS concentrations and loads were essentially the same as those observed in the 1981 (low-flow) inspection. However, with secondary treatment, the 1989 final effluent BOD_5 and TSS were greatly reduced in concentrations and receiving water loads.

Fecal coliforms have been reduced in the effluent from a range of 480-11,400/100 mL to a range of 4-8/100 mL.

TSS loading to the plant was significantly lower in the current inspection than in the August 1981 inspection (1989; 54,624 lb/D : 1981; 83,912 lb/D). Both inspections were conducted during low flow conditions. The difference in TSS loading could be the result of industrial pretreatment or could be due to normal daily fluctuations. An influent BOD load is not available from the August 1981 inspection.

The February 1982 inspection was conducted during high flow conditions (71.8 MGD) and the concentrations of conventional pollutants indicated stormwater dilution. The plant operated much more efficiently during low flow (43 percent BOD_5 and 77 percent TSS removal) than high flow (14 percent BOD_5 and 33 percent TSS removal) based on Tacoma's lab data. The current secondary plant efficiency (96 percent BOD_5 and 99 percent TSS removal at low flow conditions) is a considerable improvement. Efficiency data for high flow conditions are not yet available.

Metals and cyanide concentrations in plant effluent have been generally reduced since 1981-82. This could be the result of a combination of industrial pretreatment, secondary wastewater treatment and/or normal fluctuations in influent flow and pollutant concentrations.

Generally speaking, fewer organics and lower levels were detected in the final effluent in 1989 than in 1981-82; however, different detection levels cited for the inspections make comparisons difficult. The reader is referred to the original report for more information (Yake, 1982).

Assessment of Self-Monitoring

A comparison of laboratory results obtained by the Tacoma laboratory and Ecology on split samples is presented in Table 14.

Tacoma's influent laboratory results are consistently, and in many cases, significantly (>20%) lower than Ecology's results for BOD_5 and TSS when analyzing splits from the same sampler.

There are also differences in the BOD_5 and TSS results obtained from the Ecology and Tacoma composite samplers; Tacoma's influent was weaker and effluent was stronger than the corresponding Ecology samples. Tacoma apparently did not adequately cool their compositors as is evident by the temperatures listed under field observations in Tables 3a and 3b. This could contribute to the observed differences in analyses between samplers. Tacoma should ensure that the influent and effluent sampling points are representative of the streams being sampled.

The metals listed are those detected by at least one lab. Tacoma had consistently higher metal results on influent and effluent samples.

A laboratory review sheet is included in Appendix E of this report.

CONCLUSIONS AND RECOMMENDATIONS

The Tacoma Central plant was meeting the requirements of its NPDES permit during the inspection.

Effluent copper concentration was four and a half times the acute criteria for saltwater and cyanide was eight times both the acute and chronic criteria. Effluent ammonia was two times the chronic criteria for saltwater.

The echinoderm (sand dollar) bioassay showed this organism to be highly sensitive to the effluent. Future chronic toxicity testing should include the echinoderm bioassay.

The analysis of Puyallup River water in the area of the old discharge site and at the river mouth indicate a decrease in the concentration of at least three of the five priority pollutant metals which had been cited as exceeding water quality criteria in 1984. A PCB was detected at a level exceeding acute and chronic criteria at the old discharge site.

The recent upgrade to secondary treatment has resulted in a major improvement in effluent quality and plant efficiency.

The discrepancies in the influent TSS and BOD_5 split sample results obtained by Ecology and Tacoma need to be addressed. Further split sample analysis or the use of performance evaluation standards is recommended. Tacoma should ensure that composite samplers are adequately cooled, and that the samplers are appropriately positioned for representative samples.

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FIGURES

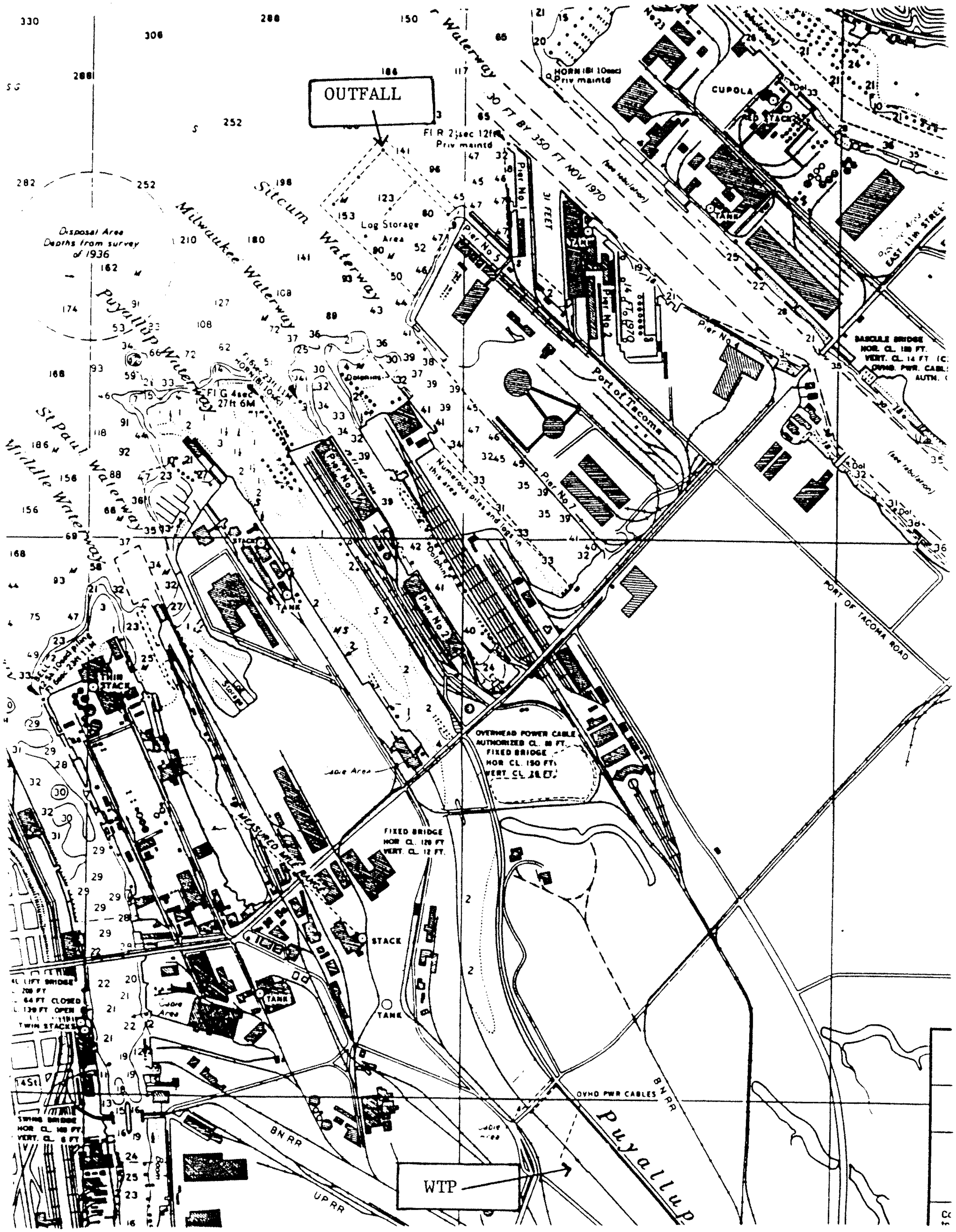

FIGURE 1. LOCATION MAP

Showing Wastewater Treatment Plant on Puyallup River
and Outfall on Commencement Bay

Tacoma Central, June 1989

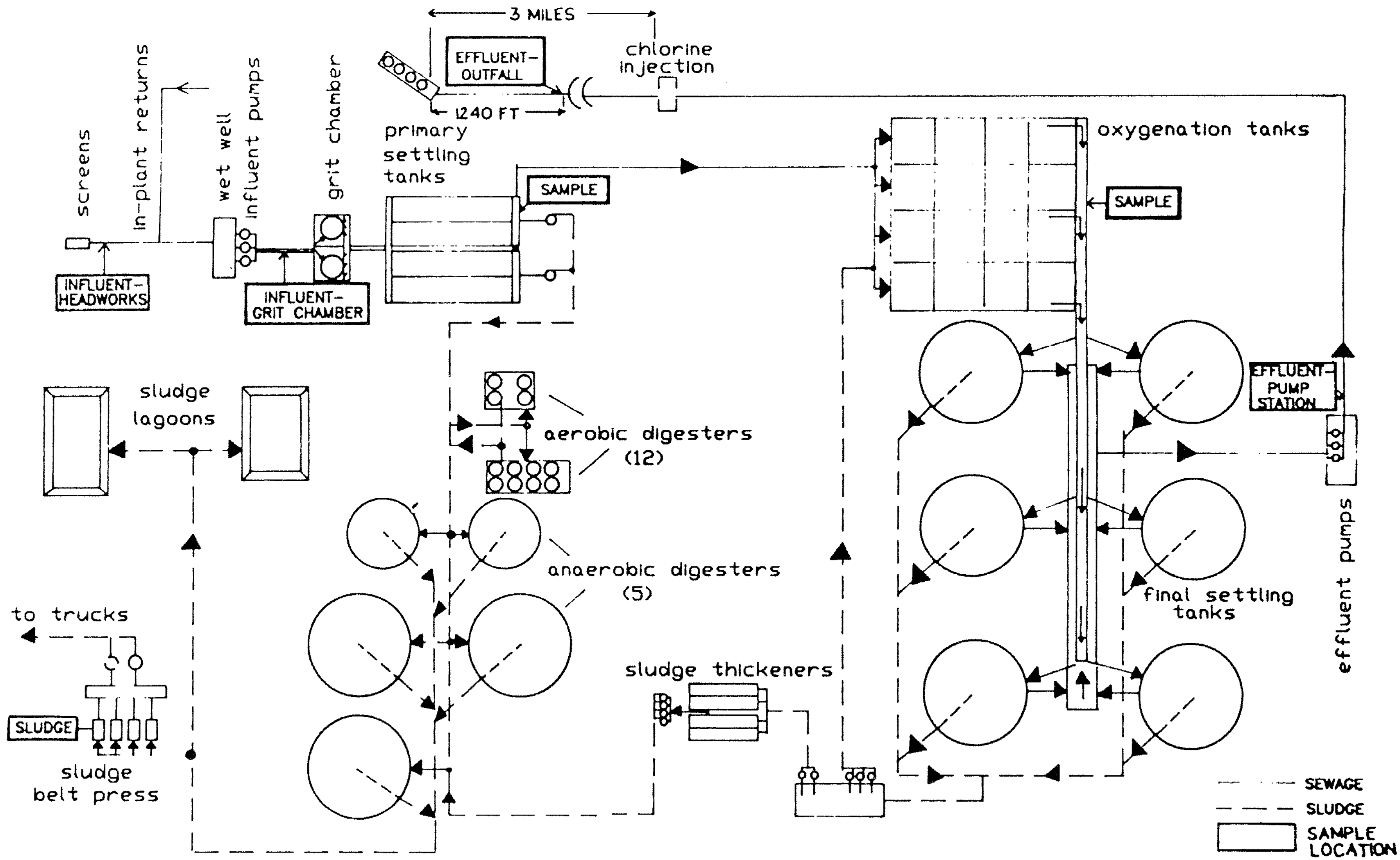

FIGURE 2 – PLANT SCHEMATIC SHOWING SAMPLING LOCATIONS

TACOMA CENTRAL-JUNE 1989

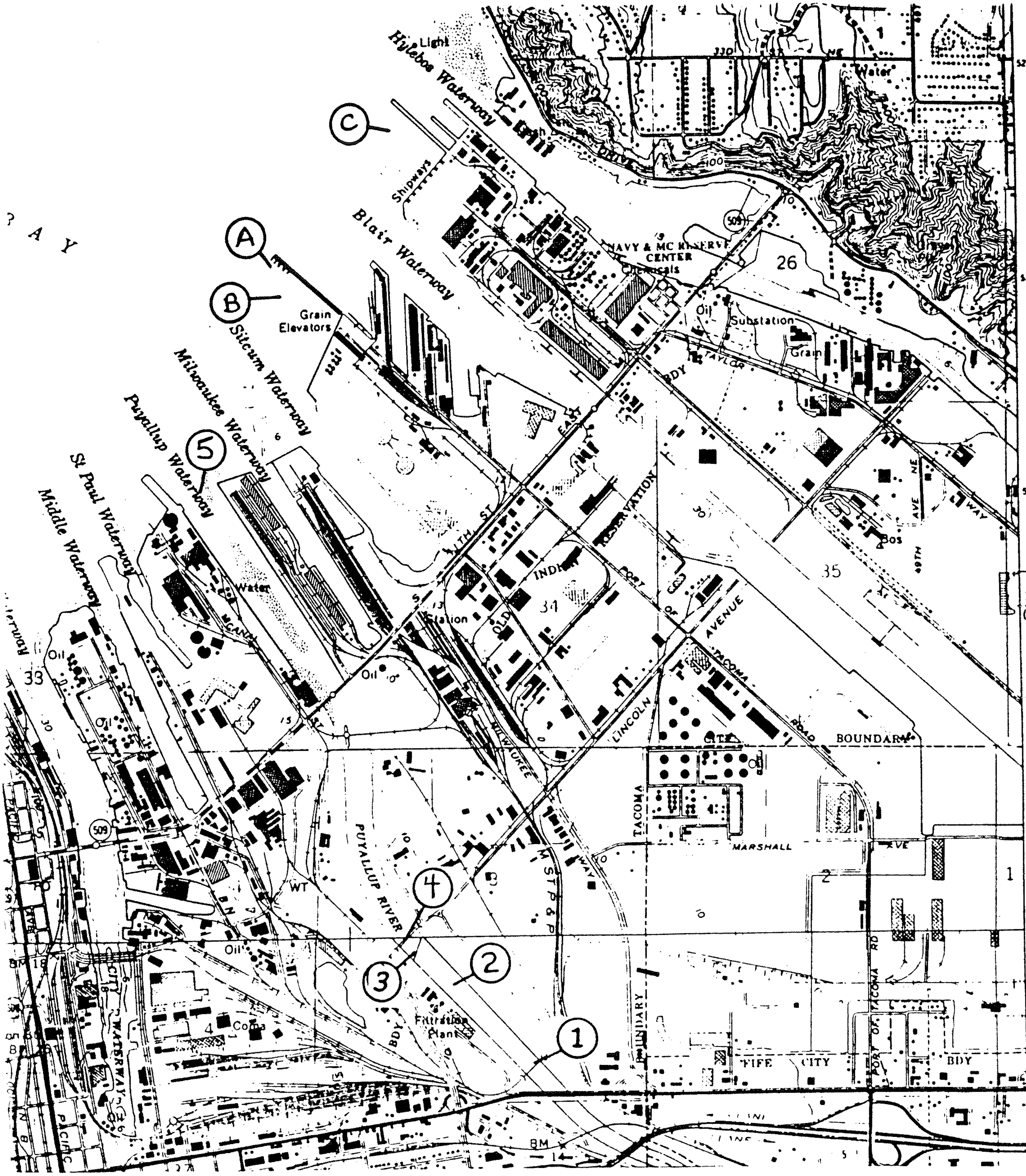

Figure 3

Puyallup River and Commencement Bay Sample Locations

Tacoma Central, June 1989

TABLES

Table 1a - Sampling times and parameters analyzed - Tacoma Central - June 26-28, 1989

Station:	Blank	Influent - Headworks		Influent - Grit Chamber					Primary Clarifiers			Oxygenation Tanks	Sludge
Sampler:	Ecology	Ecology	Ecology	Ecology	Tacoma	Ecology	Ecology	Ecology	Ecology	Ecology	Ecology	Ecology	Ecology
Type:	Grab	Composite	Grab	Composite	Composite	Grab	Grab	Grab	Composite	Grab	Grab	Grab	Grab
Date:	26	26-27	26	26-27	26-27	26	27	27	26-27	26	27	26	27
Time:		1345	1603	1405	1335	1630	0927	1855	1442	1642	0945	1735	AM
Parameter / Sample ID	268254	268243	268230	268244	268245	268255	268232	268231	268246	268233	268234	268251	268250
GENERAL CHEMISTRY													
Turbidity (NTU)		X	X		X	X	X	X					
Conductivity (umhos/cm)		X	X	X	X	X	X	X	X	X	X		
Alkalinity (mg/L as $CaCO_3$)		X	X	X	X	X	X	X	X	X	X		
Hardness (mg/L as $CaCO_3$)		X			X								
Cyanide (mg/L)	X	X											
SOLIDS (mg/L)													
TS		X		X	X				X			X	
TNVS		X		X	X				X			X	
TSS		X	X	X	X	X	X	X	X	X	X	X	
TNVSS		X		X	X				X			X	
TVSS			X			X	X	X		X	X		
BOD_5 (mg/L)		X		X	X				X				
COD (mg/L)		X	X	X	X	X	X	X	X	X	X	X	
NUTRIENTS (mg/L)													
NH_3-N		X	X	X	X	X	X	X	X	X	X		
NO_3+NO_2-N		X	X	X	X	X	X	X	X	X	X		
T-Phosphate		X	X	X	X	X	X	X	X	X	X		
O-Phosphate													
NO_2		X		X	X				X				
Fecal Coliform (#/100mL)													
% KES													
% Solids													X
Phenols (ug/L)	X	X	X	X		X		X			X		
TOC %		X											X
TOX (ug/L)							X						
Oil & Grease (mg/L)							X	X				X	
PRIORITY POLLUTANTS													
BNAs	X	X											X
Pest/PCB	X	X											X
VOA	X		X					X					
Metals+EP TOX Metals	X	X											X
BIOASSAY													
Trout													
Microtox													
Echinoderm													
Daphnia													
Fathead Minnow													
Rhepox. a.													
FIELD OBSERVATIONS													
Temperature (°C)		X	X	X	X	X	X	X	X	X	X		
pH (S.U.)		X	X	X	X	X	X	X	X	X	X		
Conductivity (umhos/cm)		X	X	X	X	X	X	X	X	X	X		
Chlorine (mg/L)													

Table 1b - Sampling times and parameters analyzed - Tacoma Central - June 26- 28, 1989

Station:	Effluent -Pump Station				Effluent - Outfall				Puyallup River Mouth	Puyallup River Old discharge	Sediments - River River mouth	Sediments - River River-old discharge	Sediments - Marine Site C	Sediments - Marine Site A	Sediments - Marine Site B
Sampler:	Ecology	Tacoma	Ecology	Ecology	Ecology	Ecology	Ecology	Ecology	Ecology	Ecology	Ecology	Ecology	Ecology	Ecology	Ecology
Type:	Composite	Composite	Grab	Grab	Composite	Grab	Grab	Grab	Grab	Grab	Grab	Grab	Grab	Grab	Grab
Date:	26-27	26-27	26	27	26-27	26	27	27	28	28	28	28	28	28	28
Time:	1430	1335	1753	1110	1640	1435	1025	1745	PM	PM	PM	PM	PM	PM	PM
Parameter Sample ID	268247	268249	268256	268257	268248	268235	268237	268236	268252	268253	268241	268242	268238	268239	268240
GENERAL CHEMISTRY															
Turbidity (NTU)	X	X	X		X	X	X	X	X	X					
Conductivity (umhos/cm)	X	X	X		X	X	X	X	X	X					
Alkalinity (mg/L as $CaCO_3$)	X	X	X		X	X	X	X	X	X					
Hardness (mg/L as $CaCO_3$)	X	X			X				X	X					
Chloride (mg/L)									X	X					
Cyanide (mg/L)					X				X	X	X	X	X	X	X
SOLIDS (mg/L)															
TS	X	X			X										
TNVS	X	X			X										
TSS	X	X	X	X	X	X	X	X	X	X					
TNVSS	X	X			X										
TVSS			X	X		X	X	X		X					
BOD_5 (mg/L)	X	X			X										
COD (mg/L)	X	X	X		X	X	X	X	X	X					
NUTRIENTS (mg/L)															
NH_3-N	X	X	X		X	X	X	X	X	X					
NO_3+NO_2-N	X	X	X		X	X	X	X	X	X					
T-Phosphate	X	X	X		X	X	X	X	X	X					
O-Phosphate	X								X	X					
NO_2	X	X			X										
Fecal Coliform (#/100mL)							X	X	X	X					
% KES									X	X					
% Solids											X	X	X	X	X
Phenols (ug/L)					X	X		X	X	X	X	X	X	X	X
TOC %					X				X	X	X	X	X	X	X
TOX (ug/L)					X										
Oil & Grease (mg/L)							X	X							
PRIORITY POLLUTANTS															
BNAs					X				X	X	X	X	X	X	X
Pest/PCB					X				X	X	X	X	X	X	X
VOA						X		X	X	X	X	X	X	X	X
Metals					X				X	X	X	X	X	X	X
BIOASSAY															
Trout					X				X	X					
Microtox					X										
Echinoderm					X										
Daphnia					X										
Fathead Minnow					X										
Rhepox. a.													X	X	X
FIELD OBSERVATIONS															
Temperature (°C)	X	X	X	X	X	X	X	X							
pH (S.U.)	X	X	X	X	X	X	X	X							
Conductivity (umhos/cm)	X	X	X	X	X	X	X	X							
Chlorine (mg/L)						X	X	X							

Table 2 - Analytical Methods and Laboratories used - Tacoma Central - June 26-28, 1989

Laboratory Analyses	Method used for Ecology analysis (Ecology, 1988)	Laboratory performing analysis
Turbidity	APHA, 1985: 214A	Ecology
Conductivity	APHA, 1985: 205	Ecology
Alkalinity	APHA, 1985: 403	Ecology
Hardness	APHA, 1985: 314B	Ecology
Cyanide	EPA, 1983: 335.2-1	Ecology
Total solids	APHA, 1985: 209A	Ecology
Total nonvolatile solids	APHA, 1985: 209D	Ecology
Total suspended solids	APHA, 1985: 209C	Ecology
Total nonvolatile suspended solids	APHA, 1985: 209D	Ecology
Total volatile suspended solids	APHA, 1985: 209D	Ecology
BOD_5	APHA, 1985: 507	Ecology
COD	APHA, 1985: 508C	Ecology
NH_3-N	EPA, 1983: 350.1	Aquatic Research Inc
NO_3+NO_2-N	EPA, 1983: 353.2	Aquatic Research Inc
T-Phosphate	EPA, 1983: 365.1	Aquatic Research Inc
O-Phosphate	EPA, 1983: 365.1	Ecology
NO_2-N	EPA, 1983: 353.2	Ecology
Fecal coliform	APHA, 1985: 909C	Ecology
% Solids	APHA, 1985: 209F	Analytical Resources Inc
Phenols	EPA, 1983: 420.1	Ecology
TOC	APHA, 1985: 505	Ecology
TOX	EPA, 1983: 450.1	Sound Analytical Serv Inc
Oil & Grease	EPA, 1983: 413.1	Ecology
BNAs (water)	EPA, 1984: 625	Laucks
BNAs (solids)	EPA, 1986a: 8270	Laucks
PCB/Pesticides (water)	EPA, 1984: 608	Laucks
PCB/Pesticides (solids)	EPA, 1986a: 8080	Laucks
Volatile organics (water)	EPA, 1984: 624	Laucks
Volatile organics (solids)	EPA, 1986a: 8240	Laucks
Metals-priority pollutant(water)	Tetra Tech, 1986	Analytical Resources Inc
Metals-priority pollutant(solid)	Tetra Tech, 1986	Analytical Resources Inc
Metals-EP tox (sludge)	EPA, 1986a: 1310	Analytical Resources Inc
Salmonid-acute	Ecology, 1981	Ecology
Daphnia pulex-acute	EPA, 1985	Ecology
Microtox-acute	Beckman	ECOVA
Echinoderm-acute/chronic	Dinnel, 1987	E.V.S.
Rhepoxynius	Tetra Tech, 1986	E.V.S.
Fathead Minnow-acute/chronic	EPA, 1989a*	ERCE Bioassay Laboratory

* This test was conducted under an EPA contract.

Table 3a - General Chemistry Results - Tacoma Central - June 26-28, 1989

Station:	Blank	Influent - Headworks		Influent - Grit chamber					Primary Clarifiers			Oxygenation Tanks	Sludge
Sampler:	Ecology	Ecology	Ecology	Ecology	WTP	Ecology	Ecology	Ecology	Ecology	Ecology	Ecology	Ecology	Ecology
Type:	Grab	Composite	Grab	Composite	Composite	Grab	Grab	Grab	Composite	Grab	Grab	Grab	Grab
Date:	26	26-27	26	26-27	26-27	26	27	27	26-27	26	27	26	27
Parameter Time:		1345	1603	1405	1335	1630	0927	1855	1442	1642	0945	1735	AM
GENERAL CHEMISTRY													
Turbidity (NTU)		120	86		110	88	85	210					
Conductivity (umhos/cm)		944	868	1140	1110	1120	1680	1290	1120	1010	1560		
Alkalinity (mg/L as $CaCO_3$)		210	230	230	230	260	240	270	220	260	260		
Hardness (mg/L as $CaCO_3$)		77			99								
Cyanide (mg/L)*	.002U	0.004											
SOLIDS (mg/L)													
TS		822		1110	1020				749			2240	
TNVS		427		574	545				477			686	
TSS		450	180	410	330	320	230	640	140	110	90	1700	
TNVSS		80		80	80				50			450	
TVSS			143			237	198	480		70	60		
BOD_5 (mg/L)		350		350	300				220				
COD (mg/L)		748	590	865	886	745	590	814	478	513	387	2780	
NUTRIENTS (mg/L)													
NH_3-N		14.7	17.6	21.0	17.2	24.1	16.6	25.2	17.4	23.3	30.0		
NO_3+NO_2-N		.02J	.07J	.03J	.02J	.06J	1.114J	.036J	.17J	.24J	.05J		
T-Phosphate		5.8J	5.9J	6.7J	7.1J	.091J	5.8J	9.4J	5.3J	5.9J	6.6J		
O-Phosphate													
NO_2		.01K		.01K	.01K				.01K				
Fecal Coliform (#/100mL)													
% KES													
% Solids													21.22
Phenols (ug/L)*	2U	38	32	58		48		32			93		
TOC %		180mg/L											25.0
TOX (ug/L)							121						
Oil & Grease (mg/L)							42	30				82	
FIELD OBSERVATIONS													
Temperature (°C)		5.9	21.1	6.2	17.2	21.3	19.2	20.4	6.6	20.5	19.0		
pH (S.U.)		7.14	7.23	7.12	7.17	7.11	7.34	7.23	7.23	7.23	7.43		
Conductivity (umhos/cm)		930	865	1182	1183	1167	1302	1855	1153	1030	1713		
Chlorine (mg/L)													

* - Units for sediments are mg/Kg dry weight
U or K - Compound was analyzed for but not detected. The associated numerical value is the sample quantitation detection limit.
J - Estimated value; not accurate.

Table 3b - General Chemistry Results - Tacoma Central - June 26-28, 1989

	Effluent - Pump Station				Effluent - Outfall				Puyallup River		Sediments - River		Sediments - Marine		
Station:									Mouth	Old discharge	Mouth	Old discharge	Site C	Site A	Site B
Sampler:	Ecology	WTP	Ecology	Ecology	Ecology	Ecology	Ecology	Ecology	Ecology	Ecology	Ecology	Ecology	Ecology	Ecology	Ecology
Type:	Composite	Composite	Grab	Grab	Composite	Grab	Grab	Grab	Grab	Grab	Grab	Grab	Grab	Grab	Grab
Date:	26-27	26-27	26	27	26-27	26	27	27	28	28	28	28	28	28	28
Parameter / Time:	1430	1335	1753	1110	1640	1435	1025	1745	PM	PM	PM	PM	PM	PM	PM
GENERAL CHEMISTRY															
Turbidity (NTU)	12	8.4	3.2		5.8	4.5	3.3	3.4	12 14						
Conductivity (umbos/cm)	974	964	979		980	1060	1150	1050	914	73					
Alkalinity (mg/L as $CaCO_3$)	200	190	210		190	200	210	180	23	24					
Hardness (mg/L as $CaCO_3$)	94	97			97				108	32					
Chloride (mg/L)									232	3.91					
Cyanide (mg/L)*					0.008				.002U	.002U	0.050	0.045	0.031	0.124	0.094
SOLIDS (mg/L)															
TS	536	537			496										
TNVS	420	365			350										
TSS	12	28	12	8	4	16	6	8	15	18					
TNVSS	8	4			4										
TVSS			0	4		8	5	8		4					
BOD_5 (mg/L)	9	22			14										
COD (mg/L)	85	115	76		76	84	4 U	65	19	5					
NUTRIENTS (mg/L)															
NH_3-N	15.7	15.5	2.0		16.6	19.4	20.5	14.0	0.72	0.29					
NO_3+NO_2-N	.06J	.06J	.02J		.06J	.04J	.03J	.05J	.10J	.21J					
T-Phosphate	4.0J	3.2J	2.7J		3.3J	3.5J	4.0J	3.7J	.059J	.071J					
O-Phosphate	5.25								0.06	0.05					
NO_2	.01K	0.02			0.09										
Fecal Coliform (#/100mL)							8	4	41	84					
% KES									26	48					
% Solids											55.35	85.90	53.53	45.73	47.31
Phenols (ug/L)*					2	2		4	2 U	2 U	0.11	.04U	0.55	0.15	0.13
TOC %					23.54mg/L				2.84mg/L	2.62mg/L	0.9	0.1	1.1	1.1	1.4
TOX (ug/L)					198										
Oil & Grease (mg/L)							1 U	2							
FIELD OBSERVATIONS															
Temperature (°C)	6.7	19.3	19.9	19.9	8.7	20.9	21.0	20.1							
pH (S.U.)	6.87	7.19	6.86	6.73	6.95	6.58	6.84	6.73							
Conductivity (umbos/cm)	1012	1051	1031	1112	1050	1128	1302	1009							
Chlorine (mg/L)						0.58	0.35	0.40							

* - Units for sediments are mg/Kg dry weight

U or K - Compound was analyzed for but not detected. The associated numerical value is the sample quantitation limit.

J - Estimated value; not accurate.

Table 4 - Comparison of Class II Inspection results to NPDES permit limit - Tacoma Central - June 26-28, 1989

Parameters	NPDES Permit Limits Monthly Average	NPDES Permit Limits Weekly Average	Ecology Inspection Results* Effluent Analysis Pump Station	Ecology Inspection Results* Effluent Analysis Outfall
BOD_5				
mg/L	30	45	9	14
lb/D	9,500	14,250	1,426	2,218
% Removal-minimum	85			
% Removal-based on headworks			97	96
% Removal-based on grit chamber			97	96
TSS				
mg/L	30	45	12	4
lb/D	9,500	14,250	1,900	634
% Removal-minimum	85			
% Removal-based on headworks			97	99
% Removal-based on grit chamber			97	99
Fecal Coliform (#/100 ml)	200	400		8 4
Flow				
MGD	38.0		19.5 (est)	19.5 (est)
pH	6.0-9.0	6.0-9.0	6.9	7.0

* Loadings based on 19.5 MGD from Tacoma's flow meter reading.

Table 5 - Comparison of Design Criteria to Inspection results - Tacoma Central
June 26-28, 1989

	Design Criteria (lb/D)	Inspection Result (lb/D) based on:		% of Design Criteria based on	
		Headworks	Grit Chamber	Headworks	Grit Chamber
Maximum Monthly BOD_5 Loading	127,000	56,900	56,900	45	45
Maximum Monthly TSS Loading	114,000	73,200	66,700	64	59

Based on 19.5 MGD flow provided from plant records.

Table 6 - Priority Pollutants detected - Tacoma Central - June 26-28, 1989

	Influent - Headworks (ug/L)	Effluent - Outfall (ug/L)	EPA Water Quality Criteria+* Saltwater Acute (ug/L)	Saltwater Chronic (ug/L)	Freshwater Acute (ug/L)	Freshwater Chronic (ug/L)
Volatile organics						
Methylene chloride	73		---	---	---	---
Acetone***	640 D		---	---	---	---
	25					
Carbon Disulfide***	6		---	---	---	---
	8					
Chloroform	15	5	---	---	28,900**	1,240**
Benzene	5		5100**	700**	5,300**	---
Toluene	28		6300**	5000**	17,500**	---
Ethylbenzene	7		430**	---	32,000**	---
Total Xylenes	41		---	---	---	---
Metals - total recoverable						
Arsenic	2	2				
(III)			69	36	360	190
Chromium	12					
(VI)			1100	50	16	11
(III)			10,300**	---	1694	202
Copper	181	13	2.9	---	17	12
Lead	46	2	140	5.6	79	3.1
Mercury	0.6		2.1	0.025	2.4	0.012
Zinc	334	39	170	58	313	47
Cyanide	4	8	1.0	1.0	22	5.2

+ EPA, 1986.
* hardness dependent criteria based on 97 mg/L hardness as $CaCO_3$ in outfall effluent
** value is the L.O.E.L. - Lowest observed effect level
*** present in two influent grabs
D indicates the value was from the analysis of a diluted sample

Table 7 - Sludge metals results compared to Criteria - Tacoma Central - June 26-28, 1989

Total Priority Pollutant Metals	Sludge analysis (mg/Kg dry wt)	EPA proposed* maximum conc. (mg/Kg dry wt)	Data from previous inspections** Mean (mg/Kg dry weight)	Range	Number of samples
Antimony	5.68				
Arsenic	7.7	36			
Beryllium	0.43 U				
Cadmium	8.06	380	7.6	0.1 - 25	34
Chromium	58.8	3100	61.8	15 - 300	34
Copper	773	3300	398	75 - 1700	34
Lead	212	1600	207	34 - 600	34
Mercury	4.91	30			
Nickel	26.5	990	25.5	0.1 - 62	29
Selenium	14.9	64			
Silver	82.9				
Thallium	0.43 U				
Zinc	1210	8600	1200	165 - 3370	33
% Solids	21.2				

EP TOX Metals	Sludge analysis (mg/L)	Dangerous Waste Concentration*** (mg/L)
Arsenic	0.05 U	5.0- 500
Barium	0.177	100.0-10,000
Cadmium	0.002 U	1.0- 100
Chromium	0.005 U	5.0- 500
Lead	0.03 U	5.0- 500
Mercury	0.0001 U	0.2- 20
Selenium	0.05 U	1.0- 100
Silver	0.003 U	5.0- 500

* Proposed maximum concentration for non-agricultural land application. (EPA, 1989).

** Summary of data collected on digested sludge from activated sludge plants from previous inspections (Hallinan, 1988).

*** EPA, 1986a.

U - Compound was analyzed for but not detected. The associated numerical value is the sample quantitation detection limit.

Table 8 - Bioassay Results - Tacoma Central - June 26-28, 1989

Effluent Bioassays

48 hour *Daphnia pulex* - 100% concentration

	# of live organisms Initial	Final	Percent Mortality
100% Effluent	20	20	0
Control	20	20	0

96 hour Rainbow Trout (*Oncorhyncus mykiss*, formerly *Salmo gairdneri*)

	# of live test organisms Initial	Final	Percent Mortality
100% Effluent	30	27	10
Control	30	30	0

15 minute Microtox (*Photobacterium phosphoreum*) EC50 = 68.1% (15°C)

7 day Fathead Minnow (*Pimephales promelas*)
NOEC = 25.0%
LOEC = 50.0%
96 hr LC50 = 68%

Echinoderm (sand dollar, *Dendraster excentricus*)
NOEC = <0.1%
LOEC = 0.1%
EC50 = 3.2%

EC50 - the "effective concentration" at which the response of interest for half of the test organisms is observed.
LC50 - the concentration of effluent that causes mortality to half of the test organisms.
NOEC - the highest concentration of effluent which produces no statistically significant response by the test organisms.
LOEC - the lowest observable effect concentration shown to cause a statistically significant response by the test organism.

Table 8 - continued

Sediment Bioassays

Amphipod (Rhepoxynius abronius)

Sample	Mean Values±S.D. Survival(1)	Avoidance(2)	%Reburial(3)
Site A - Outfall	17.6±0.5	0.1±0.4	100
Site B - Near Outfall	17.6±1.3	0.2±0.4	100
Site C - Background	16.6±2.4	0.8±1.3	100
Analytical control	19.6±0.9	0.2±0.5	100

(1) - Average of: 20 amphipods per replicate with five replicates per sample.
(2) - Number of amphipods on liquid surface per day out of twenty.
(3) - % of amphipods able to rebury in clean sediment at end of test period.

Puyallup River Bioassays

96 hour Rainbow Trout (Oncorhyncus mykiss, formerly Salmo gairdneri)

Sample	# of live test organisms Initial	Final	Percent Mortality
Above Old Discharge	30	30	0
River Mouth	30	30	0
Control	30	30	0

Table 9 - Bioassays and Ammonia Water Quality Criteria - Tacoma Central - June 26-28, 1989

Species	Test Conditions		Total Ammonia in Effluent* $(mg/L\ NH_3)$	Ammonia Water Quality Criteria**			
				Chronic-4 day		Acute-1 hour	
	Temperature C	pH (maximum observed)		Fresh water $(mg/L\ NH_3)$	Salt+ water	Fresh water $(mg/L\ NH_3)$	Salt+ water
Rainbow Trout	12	7.7	20.2	2.1		10.7	
Daphnia pulex	20	8.1	20.2	0.77		5.64	
Microtox	15	7.0	20.2	2.2		24.0	
Fathead Minnow	25	8.0	20.2	0.93		6.80	
Echinoderm	15	7.0	20.2		14		92

* Total Ammonia in Effluent-Outfall composite. Calculated from NH_3-N value (16.6 mg/L).
** EPA, 1986 and EPA, 1989b.
\+ For Salinity = 20 g/Kg

Table 10 - Commencement Bay sediment samples chemistry and Ecology Criteria
Tacoma Central - June 26-28, 1989

SITE	Commencement Bay C (Background)	A (Outfall)	B (Near Outfall)	*Sediment Criteria** (mg/Kg dry wt)
Cyanide (mg/Kg dry wt)	0.031	0.124	0.094	--
Phenols (mg/Kg dry wt)	0.55	0.15	0.13	--
TOC %	1.1	1.1	1.4	--
Organics - detected (mg/Kg dry wt)				
Acetone	.097	.033	.033	--
Phenol	.690J	--	--	.420
Fluoranthene (TOC basis)	15J	10J	6J	160
Pyrene (TOC basis)	16J	9J	6J	1000
Metals-detected (mg/Kg dry wt)				
Antimony	0.3	--	--	150
Arsenic	8.4	5.7	6.6	57
Beryllium	0.26	0.33	0.30	--
Chromium	17.1	21.3	20.4	260
Copper	38.7	38.9	38.8	390
Lead	18.9	16.2	16.8	450
Mercury	0.14		0.13	0.41
Nickel	12.6	16.4	15.7	NV (1)
Zinc	48.7	48.2	47.5	410

J Indicates an estimated value when result is less than the specified detection limit.

* Chemical criteria from Ecology's Interim Sediment Quality Evaluation Process For Puget Sound (Betts, 1989).

(1) A criteria is not established.

NOTE - See Figure 3 for the locations of SITE A, B, and C.

NOTE - Grain size analysis is included in Appendix D.

Table 11 - Puyallup River Water Samples: 1981, 1984, and 1989 - Tacoma Central - June 26-28, 1989

River Samples	Site 2 July/1981*	Site 2 Aug/1981* (high slack)	Site 2 Aug/1981* (ebb)	Site 4 May/1984**	Site 2 June/1989	EPA Water Quality + Criteria-Freshwater (hardness=32 mg/L) Acute (ug/L)	EPA Water Quality + Criteria-Freshwater (hardness=32 mg/L) Chronic (ug/L)	SITE 5 Aug/1981* (high slack)	SITE 5 May/1984**	SITE 5 June/1989	EPA Water Quality+ Criteria-Freshwater (hardness=108 mg/L) Acute (ug/L)	EPA Water Quality+ Criteria-Freshwater (hardness=108 mg/L) Chronic (ug/L)
Flow (cfs)	2550	---	1790		2610							
Turbidity (NTU)		140	150		14			230		12		
Conductivity (umhos/cm)		609	118		73			771		914		
TSS (mg/L)		160	270		18			600		15		
COD (mg/L)		260	9		5			40		19		
NH3-N (mg/L)		7.8	0.46		0.29			0.11		0.72		
T-PO4-P (mg/		3.6	0.18		0.071 J			0.18		0.059 J		
O-PO4-P (mg/L)		2.0	0.13		0.05			0.06		0.06		
Fecal Coliform (#/100ml)		390	480		84			840		41		
		350	150					140				
Phenols (ug/L)		13	9		2 U			11		2 U		
Organics (ug/L)												
Phenol		80			10 U	10,200	2,560	--		10 U	10,200	2,560
Aroclor-1242					2.2	2.0	0.014			0.50 U	2.0	0.014
Metals (ug/L)												
Arsenic	18	8	4	<1	1 U			11	6	1 U		
(III)						360	190				360	190
Cadmium	10	<5	<5	<1	2 U	1.1	0.46	<5	<1	2 U	4.3	1.2
Chromium	<2	<10	<10	7	5 U			<10	10	5 U		
(VI)						16	11				16	11
(III)						683	81				1,849	220
Copper	10	30	<10	9	4	6	4.5	20	29	4	19	13
Lead	<100	<20	<20	2	1 U	19	0.75	<20	12	2	90	3.5
Mercury	0.24	0.32	0.20	<0.1	0.1	2.4	0.012	<0.20	0.1	0.1 U	2.4	0.012
Nickel	<1	<10	<10	11	10 U	776	40	<10	31	10 U	1,956	101
Zinc	30	140	28	30	5	125	47	15	60	4 U	342	47
Bioassay												
Rainbow Trout (% survival in 100% solution)					100					100		

U = Compound was analyzed for but not detected. The associated numerical value is the sample quantitation detection limit.
J = Estimated value; not accurate.

\+ - EPA, 1986.
* - Johnson and Prescott, 1982
** - Ebbert et al., 1987.

Site 2 - Above old discharge site
Site 4 - Puyallup River at Lincoln Ave.
Site 5 - River mouth

(See figure 3 for Site locations)

Table 12 - Puyallup River Sediment Samples: 1981 and 1989 - Tacoma Central - June 26-28, 1989

Sediment Samples	Site 1 Aug 1981	Outfall Area Site 3 Aug. 1981	Site 2 June 1989	River Mouth Site 5 Aug. 1981	Site 5 June 1989
Metals (mg/Kg dry wt)					
Arsenic	9.4	8.0	1.01	5.4	2.6
Cadmium	0.19	0.56	0.17 U	0.17	0.29 U
Chromium	4.6	7.9	11.7	3.8	15.2
Copper	20	28	11.7	16	29.4
Lead	5.8	12	4.1	3.4	6.5
Mercury	0.89	0.28	0.05	0.09	0.07 U
Nickel	9.7	12	8.5	8.1	11.8
Zinc	14	42	21.9	13	32.5
% TOC			1.0		8.6

Site 1 - 1800' above WTP outfall
Site 2 - 10 meters above WTP outfall
Site 3 - 600' below WTP outfall
Site 5 - River mouth

NOTE - Grain size analysis is included in Appendix C.

Table 13 - Comparison of 1981/82 final effluent with 1989 primary and secondary effluent*-Tacoma Central June 26-28, 1989.

	Final Effluent (primary) Aug 1981	Final Effluent (primary) Feb 1982	Effluent (primary) July 1989	Final Effluent (secondary) July 1989
Flow (MGD)	16.5	71.8	19.5 (est)	19.5 (est)
BOD_5				
mg/L	250	120	220	14
lb/D	34,000	72,000	35,766	2,218
TSS				
mg/L	170	81	140	4
lb/D	23,000	49,000	22,760	634
Fecal coliform				
#/100 ml	2,600	2,200		8
(2 grab samples)	11,400	480		4
Metals detected (ug/L)				

Arsenic	12	23		2
Cadmium	2	1		2 U
Chromium	76	<10		5 U
Copper	53	50		13
Lead	39	80		2
Mercury	0.63	<0.2		0.1 U
Nickel	59	170		10 U
Zinc	340	130		39
Cyanide (ug/L)	18	85		8

U - Compound was analyzed for but not detected. The associated numerical value is the sample quantitation detection limit.

* - Composite sample results except for fecal califorms.

Table 14 - Comparison of inter-laboratory results: Ecology and WTP - Tacoma Central - June 26-28, 1989

Station	Sampler	Laboratory	BOD_5 (mg/L)	TSS (mg/L)	Arsenic (ug/L)	Cadmium (ug/L)	Chromium (ug/L)	Copper (ug/L)	Lead (ug/L)	Mercury (ug/L)	Zinc (ug/L)	Cyanide (ug/L)
Influent (headworks)	Ecology	Ecology	350	450	2	2 U	12	181	46	0.6	334	4
		Tacoma	305	336								
Influent (grit chamber)	Ecology	Ecology	350	410								
	Tacoma	Ecology	300	330								
		(Average)	(325)	(370)								
	Mix*	Tacoma	280	327	5	3.1	50	366	60	2.6	475	5
Effluent (pump station)	Ecology	Ecology	9	12								
		Tacoma	10	10								5
Effluent (pump station)	Tacoma	Ecology	22	28								
		Tacoma	19	38	5	0.6	50	113	8	0.2	115	5
Effluent (outfall)	Ecology	Ecology	14	4	2	2 U	5 U	13	2	0.1 U	39	8
		Tacoma			5	0.5	50	86	5	0.2	82	10.5

* - Tacoma combined the splits from the grit chamber composites and analyzed a single sample
U - Compound was analyzed for but not detected. The associated numerical value is the sample quantitation detection limit.

APPENDIX A

PRIORITY POLLUTANT CLEANING PROCEDURES

Appendix A

Priority Pollutant Sampling Equipment Cleaning Procedures

1. Wash with laboratory detergent
2. Rinse several times with tap water
3. Rinse with 10 percent HNO_3 solution
4. Rinse three times with distilled/deionized water
5. Rinse with high purity methylene chloride
6. Rinse with high purity acetone
7. Allow to dry and seal with aluminum foil

APPENDIX B

PRIORITY POLLUTANT SCANS

Appendix B - Results of priority pollutant scan - Tacoma Central June 1989

Station:	Influent Headworks	Influent Grit Chamber	Effluent Outfall	Effluent Outfall	Blank	River Mouth	River Old disch.	Sediment Site C	Sediment Site A	Sediment Site B	Sediment Mouth	Sediment Old disch
Type:	Grab	Grab	Grab	Grab	Grab	Grab	Grab	Grab	Grab	Grab	Grab	Grab
Date:	06-26-89	06-27-89	06-26-89	06-27-89	06-26-89	06-28-89	06-28-89	06-28-89	06-28-89	06-28-89	06-28-89	06-28-89
Time:	PM	PM	PM	AM	AM	PM	PM	PM	PM	PM	PM	PM
Sample ID #:	268230	268231	268235	268236	268254	268252	268253	268238	268239	268240	268241	268242
VOA Compounds	(ug/L)	(ug/L)	(ug/L)	(ug/L)	(ug/L)	(ug/L)	(ug/L)	(ug/Kg)	(ug/Kg)	(ug/Kg)	(ug/Kg)	(ug/Kg)
Chloromethane	10 U	10 U	10 U	10 U	10 U	10 U	10 U	25 U	30 U	30 U	26 U	18 U
Bromomethane	10 U	10 U	10 U	10 U	10 U	10 U	10 U	25 U	30 U	30 U	26 U	18 U
Vinyl Chloride	10 U	10 U	10 U	10 U	10 U	10 U	10 U	25 U	30 U	30 U	26 U	18 U
Chloroethane	10 U	10 U	10 U	10 U	10 U	10 U	10 U	25 U	30 U	30 U	26 U	18 U
Methylene Chloride	73	5 U	5 U	2 J	5 U	16	52	13 U	15 U	15 U	5 J	3 J
Acetone	640 D	25	10 U	10 U	10 U	25	48	97	33	33	57	18 U
Carbon Disulfide	6	8	5 U	5 U	5 U	5 U	5 U	13 U	15 U	15 U	13 U	9 U
1,1-Dichloroethene	5 U	5 U	5 U	5 U	5 U	5 U	5 U	13 U	15 U	15 U	13 U	9 U
1,1-Dichloroethane	5 U	5 U	5 U	5 U	5 U	5 U	5 U	13 U	15 U	15 U	13 U	9 U
Chloroform	15	3 J	5	4 J	5 U	5 U	5 U	13 U	15 U	15 U	13 U	9 U
1,2-Dichloroethane	5 U	5 U	5 U	5 U	5 U	5 U	5 U	13 U	15 U	15 U	13 U	9 U
2-Butanone	10 U	10 U	10 U	10 U	10 U	10 U	10 U	25 U	30 U	30 U	26 U	18 U
1,1,1-Trichloroethane	5 U	5 U	5 U	5 U	5 U	5 U	5 U	13 U	15 U	15 U	13 U	9 U
Carbon Tetrachloride	5 U	5 U	5 U	5 U	5 U	5 U	5 U	13 U	15 U	15 U	13 U	9 U
Vinyl Acetate	10 U	10 U	10 U	10 U	10 U	10 U	10 U	25 U	30 U	30 U	26 U	18 U
Bromodichloromethane	5 U	5 U	5 U	5 U	5 U	5 U	5 U	13 U	15 U	15 U	13 U	9 U
1,2-Dichloropropane	5 U	5 U	5 U	5 U	5 U	5 U	5 U	13 U	15 U	15 U	13 U	9 U
trans-1,3-Dichloropropene	5 U	5 U	5 U	5 U	5 U	5 U	5 U	13 U	15 U	15 U	13 U	9 U
Trichloroethene	5 U	5 U	5 U	5 U	5 U	5 U	5 U	13 U	15 U	15 U	13 U	9 U
Dibromochloromethane	5 U	5 U	5 U	5 U	5 U	5 U	5 U	13 U	15 U	15 U	13 U	9 U
1,1,2-Trichloroethane	5 U	5 U	5 U	5 U	5 U	5 U	5 U	13 U	15 U	15 U	13 U	9 U
Benzene	5 U	5	5 U	5 U	5 U	5 U	5 U	13 U	15 U	15 U	13 U	9 U
cis-1,3-Dichloropropene	5 U	5 U	5 U	5 U	5 U	5 U	5 U	13 U	15 U	15 U	13 U	9 U
2-Chloroethylvinylether												
Bromoform	5 U	5 U	5 U	5 U	5 U	5 U	5 U	13 U	15 U	15 U	13 U	9 U
4-Methyl-2-Pentanone	10 U	10 U	10 U	10 U	10 U	10 U	10 U	25 U	30 U	30 U	26 U	18 U
2-Hexanone	10 U	10 U	10 U	10 U	10 U	10 U	10 U	25 U	30 U	30 U	26 U	18 U
Tetrachloroethene	2 J	1 J	1 J	2 J	5 U	5 U	5 U	13 U	15 U	15 U	13 U	9 U
1,1,2,2-Tetrachloroethane	5 U	5 U	5 U	5 U	5 U	5 U	5 U	13 U	15 U	15 U	13 U	9 U
Toluene	5 J	28	5 U	5 U	5 U	5 U	5 U	13 U	15 U	15 U	13 U	9 U
Chlorobenzene	5 U	5 U	5 U	5 U	5 U	5 U	5 U	13 U	15 U	15 U	13 U	9 U
Ethylbenzene	5 U	7	5 U	5 U	5 U	5 U	5 U	13 U	15 U	15 U	13 U	9 U
Styrene	5 U	5 U	5 U	5 U	5 U	5 U	5 U	13 U	15 U	15 U	13 U	9 U
Total Xylenes	3 J	41	5 U	5 U	5 U	5 U	5 U	13 U	15 U	15 U	13 U	9 U
1,2-Dichloroethene (total)	5 U	5 U	5 U	5 U	5 U	5 U	5 U	13 U	15 U	15 U	13 U	9 U

Appendix B (Continued)

Station:	Influent Headworks	Effluent Outfall	Blank	River Mouth	River Old disch	Sediment Site C	Sediment Site A	Sediment Site B	Sediment Mouth	Sediment Old disch	Sludge
Type:	composite	composite	grab AM	grab PM	grab PM	grab PM	grab PM	grab PM	grab PM	grab PM	grab AM
Date:	06-27-89	06-27-89	06-26-89	06-28-89	06-28-89	06-28-89	06-28-89	06-28-89	06-28-89	06-28-89	06-27-89
Sample ID#:	268243	268248	268254	268252	268253	268238	268239	268240	268241	268242	168250
BNA Compounds	(ug/L)	(ug/L)	(ug/L)	(ug/L)	(ug/L)	(ug/Kg)	(ug/Kg)	(ug/Kg)	(ug/Kg)	(ug/Kg)	(ug/Kg)
Phenol	8 J	10 U	10 U	10 U	10 U	690 J	1400 U	1400 U	1200 U	410 U	2000 J
Bis(2-Chloroethyl)Ether	50 U	10 U	10 U	10 U	10 U	2900 U	1400 U	1400 U	1200 U	410 U	16000 U
2-Chlorophenol	50 U	10 U	10 U	10 U	10 U	2900 U	1400 U	1400 U	1200 U	410 U	16000 U
1,3-Dichlorobenzene	50 U	10 U	10 U	10 U	10 U	2900 U	1400 U	1400 U	1200 U	410 U	16000 U
1,4-Dichlorobenzene	50 U	10 U	10 U	10 U	10 U	2900 U	1400 U	1400 U	1200 U	410 U	16000 U
Benzyl Alcohol	50 U	10 U	10 U	10 U	10 U	2900 U	1400 U	1400 U	1200 U	410 U	16000 U
1,2-Dichlorobenzene	50 U	10 U	10 U	10 U	10 U	2900 U	1400 U	1400 U	1200 U	410 U	16000 U
2-Methylphenol	50 U	10 U	10 U	10 U	10 U	2900 U	1400 U	1400 U	1200 U	410 U	16000 U
Bis(2-chloroisopropyl)ether	50 U	10 U	10 U	10 U	10 U	2900 U	1400 U	1400 U	1200 U	410 U	16000 U
4-Methylphenol	16 J	10 U	10 U	10 U	10 U	2900 U	1400 U	1400 U	1200 U	410 U	16000 U
N-Nitroso-Di-n-Propylamine	50 U	10 U	10 U	10 U	10 U	2900 U	1400 U	1400 U	1200 U	410 U	16000 U
Hexachloroethane	50 U	10 U	10 U	10 U	10 U	2900 U	1400 U	1400 U	1200 U	410 U	16000 U
Nitrobenzene	50 U	10 U	10 U	10 U	10 U	2900 U	1400 U	1400 U	1200 U	410 U	16000 U
Isophorone	50 U	10 U	10 U	10 U	10 U	2900 U	1400 U	1400 U	1200 U	410 U	16000 U
2-Nitrophenol	50 U	10 U	10 U	10 U	10 U	2900 U	1400 U	1400 U	1200 U	410 U	16000 U
2,4-Dimethylphenol	50 U	10 U	10 U	10 U	10 U	2900 U	1400 U	1400 U	1200 U	410 U	16000 U
Benzoic Acid	250 U	50 U	50 U	50 U	50 U	14000 U	6900 U	6700 U	5800 U	2000 U	77000 U
Bis(2-Chloroethoxy)Methane	50 U	10 U	10 U	10 U	10 U	2900 U	1400 U	1400 U	1200 U	410 U	16000 U
2,4-Dichlorophenol	50 U	10 U	10 U	10 U	10 U	2900 U	1400 U	1400 U	1200 U	410 U	16000 U
1,2,4-Trichlorobenzene	50 U	10 U	10 U	10 U	10 U	2900 U	1400 U	1400 U	1200 U	410 U	16000 U
Naphthalene	50 U	10 U	10 U	10 U	10 U	2900 U	1400 U	1400 U	1200 U	410 U	16000 U
4-Chloroaniline	50 U	10 U	10 U	10 U	10 U	2900 U	1400 U	1400 U	1200 U	410 U	16000 U
Hexachlorobutadiene	50 U	10 U	10 U	10 U	10 U	2900 U	1400 U	1400 U	1200 U	410 U	16000 U
4-Chloro-3-Methylphenol	50 U	10 U	10 U	10 U	10 U	2900 U	1400 U	1400 U	1200 U	410 U	16000 U
2-Methylnaphthalene	50 U	10 U	10 U	10 U	10 U	2900 U	1400 U	1400 U	1200 U	410 U	2900 J
Hexachlorocyclopentadiene	50 U	10 U	10 U	10 U	10 U	2900 U	1400 U	1400 U	1200 U	410 U	16000 U
2,4,6-Trichlorophenol	50 U	10 U	10 U	10 U	10 U	2900 U	1400 U	1400 U	1200 U	410 U	16000 U
2,4,5-Trichlorophenol	250 U	50 U	50 U	50 U	50 U	14000 U	6900 U	6700 U	5800 U	2000 U	77000 U
2-Chloronaphthalene	50 U	10 U	10 U	10 U	10 U	2900 U	1400 U	1400 U	1200 U	410 U	16000 U
2-Nitroaniline	250 U	50 U	50 U	50 U	50 U	14000 U	6900 U	6700 U	5800 U	2000 U	77000 U
Dimethyl Phthalate	50 U	10 U	10 U	10 U	10 U	2900 U	1400 U	1400 U	1200 U	410 U	16000 U
Acenaphthylene	50 U	10 U	10 U	10 U	10 U	2900 U	1400 U	1400 U	1200 U	410 U	16000 U
3-Nitroaniline	250 U	50 U	50 U	50 U	50 U	14000 U	6900 U	6700 U	5800 U	2000 U	77000 U
Acenaphthene	50 U	10 U	10 U	10 U	10 U	2900 U	1400 U	1400 U	1200 U	410 U	16000 U
2,4-Dinitrophenol	250 U	50 U	50 U	50 U	50 U	14000 U	6900 U	6700 U	5800 U	2000 U	77000 U
4-Nitrophenol	250 U	50 U	50 U	50 U	50 U	14000 U	6900 U	6700 U	5800 U	2000 U	77000 U
Dibenzofuran	50 U	10 U	10 U	10 U	10 U	2900 U	1400 U	1400 U	1200 U	410 U	700 J
2,4-Dinitrotoluene	50 U	10 U	10 U	10 U	10 U	2900 U	1400 U	1400 U	1200 U	410 U	16000 U
2,6-Dinitrotoluene	50 U	10 U	10 U	10 U	10 U	2900 U	1400 U	1400 U	1200 U	410 U	16000 U
Diethyl Phthalate	5 J	10 U	10 U	10 U	10 U	2900 U	1400 U	1400 U	1200 U	410 U	16000 U
4-Chlorophenyl-Phenylether	50 U	10 U	10 U	10 U	10 U	2900 U	1400 U	1400 U	1200 U	410 U	16000 U
Fluorene	50 U	10 U	10 U	10 U	10 U	2900 U	1400 U	1400 U	1200 U	410 U	16000 U
4-Nitroaniline	250 U	50 U	50 U	50 U	50 U	14000 U	6900 U	6700 U	5800 U	2000 U	77000 U
4,6-Dinitro-2-Methylphenol	250 U	50 U	50 U	50 U	50 U	14000 U	6900 U	6700 U	5800 U	2000 U	77000 U
N-Nitrosodiphenylamine	50 U	10 U	10 U	10 U	10 U	2900 U	1400 U	1400 U	1200 U	410 U	16000 U
4-Bromophenyl-Phenylether	50 U	10 U	10 U	10 U	10 U	2900 U	1400 U	1400 U	1200 U	410 U	16000 U

Appendix B (Continued)

Station:	Influent Headworks	Effluent Outfall	Blank	River Mouth	River Old disch	Sediment Site C	Sediment Site A	Sediment Site B	Sediment Mouth	Sediment Old disch	Sludge
Type:	composite	composite	grab AM	grab PM	grab PM	grab PM	grab PM	grab PM	grab PM	grab PM	grab AM
Date:	06-27-89	06-27-89	06-26-89	06-28-89	06-28-89	06-28-89	06-28-89	06-28-89	06-28-89	06-28-89	06-27-89
Sample ID #:	268243	268248	268254	268252	268253	268238	268239	268240	268241	268242	268250
Hexachlorobenzene	50 U	10 U	10 U	10 U	10 U	2900 U	1400 U	1400 U	1200 U	410 U	16000 U
Pentachlorophenol	250 U	50 U	50 U	50 U	50 U	14000 U	6900 U	6700 U	5800 U	2000 U	77000 U
Phenanthrene	50 U	10 U	10 U	10 U	10 U	2900 U	1400 U	1400 U	1200 U	410 U	3100 J
Anthracene	50 U	10 U	10 U	10 U	10 U	2900 U	1400 U	1400 U	1200 U	410 U	16000 U
Di-n-Butyl Phthalate	50 U	10 U	10 U	10 U	10 U	2900 U	1400 U	1400 U	1200 U	410 U	16000 U
Fluoranthene	50 U	10 U	10 U	10 U	10 U	160 J	110 J	84 J	1200 U	410 U	1900 J
Pyrene	50 U	10 U	10 U	10 U	10 U	180 J	100 J	91 J	1200 U	410 U	2900 J
Butylbenzylpthalate	50 U	10 U	10 U	10 U	10 U	2900 U	1400 U	1400 U	1200 U	410 U	2500 J
3,3'-Dichlorobenzidine	100 U	20 U	20 U	20 U	20 U	5900 U	2900 U	2800 U	2400 U	820 U	32000 U
Benzo(a)Anthracene	50 U	10 U	10 U	10 U	10 U	2900 U	1400 U	1400 U	1200 U	410 U	1500 J
Chrysene	50 U	10 U	10 U	10 U	10 U	2900 U	1400 U	1400 U	1200 U	410 U	1300 J
Bis(2-Ethylhexyl)phthalate	52 UJ	5 JB	8 JB	2 UJ	12 B	450 UJ	660 JB	650 JB	360 JB	140 J	250000
Di-n-Octyl Phthalate	50 U	10 U	10 U	10 U	10 U	2900 U	1400 U	1400 U	1200 U	410 U	16000 J
Benzo(b)Fluoranthene	50 U	10 U	10 U	10 U	10 U	2900 U	1400 U	1400 U	1200 U	410 U	16000 U
Benzo(k)Fluoranthene	50 U	10 U	10 U	10 U	10 U	2900 U	1400 U	1400 U	1200 U	410 U	16000 U
Benzo(a)Pyrene	50 U	10 U	10 U	10 U	10 U	2900 U	1400 U	1400 U	1200 U	410 U	16000 U
Indeno(1,2,3-cd)Pyrene	50 U	10 U	10 U	10 U	10 U	2900 U	1400 U	1400 U	1200 U	410 U	16000 U
Dibenzo(a,h)Anthracene	50 U	10 U	10 U	10 U	10 U	2900 U	1400 U	1400 U	1200 U	410 U	16000 U
Benzo(g,h,i)Perylene	50 U	10 U	10 U	10 U	10 U	2900 U	1400 U	1400 U	1200 U	410 U	16000 U
Pesticide/PCB Compounds	(ug/L)	(ug/L)	(ug/L)	(ug/L)	(ug/L)	(ug/Kg)	(ug/Kg)	(ug/Kg)	(ug/Kg)	(ug/Kg)	(ug/Kg)
alpha-BHC	0.05 U	0.05 U	0.05 U	0.050 U	0.05 U	14 U	17 U	17 U	14 U	10 U	38 U
beta-BHC	0.05 U	0.05 U	0.05 U	0.050 U	0.05 U	14 U	17 U	17 U	14 U	10 U	38 U
delta-BHC	0.05 U	0.05 U	0.05 U	0.050 U	0.05 U	14 U	17 U	17 U	14 U	10 U	38 U
gamma-BHC (Lindane)	0.05 U	0.05 U	0.05 U	0.050 U	0.05 U	14 U	17 U	17 U	14 U	10 U	38 U
Heptachlor	0.05 U	0.05 U	0.05 U	0.050 U	0.05 U	14 U	17 U	17 U	14 U	10 U	38 U
Aldrin	0.05 U	0.05 U	0.05 U	0.050 U	0.05 U	14 U	17 U	17 U	14 U	10 U	38 U
Heptachlor Epoxide	0.05 U	0.05 U	0.05 U	0.050 U	0.05 U	14 U	17 U	17 U	14 U	10 U	38 U
Endosulfan I	0.05 U	0.05 U	0.05 U	0.050 U	0.05 U	14 U	17 U	17 U	14 U	10 U	38 U
Dieldrin	0.10 U	0.10 U	0.10 U	0.10 U	0.10 U	28 U	35 U	33 U	29 U	20 U	77 U
4,4'-DDE	0.10 U	0.10 U	0.10 U	0.10 U	0.10 U	28 U	35 U	33 U	29 U	20 U	77 U
Endrin	0.10 U	0.10 U	0.10 U	0.10 U	0.10 U	28 U	35 U	33 U	29 U	20 U	77 U
Endosulfan II	0.10 U	0.10 U	0.10 U	0.10 U	0.10 U	28 U	35 U	33 U	29 U	20 U	77 U
4,4'-DDD	0.10 U	0.10 U	0.10 U	0.10 U	0.10 U	28 U	35 U	33 U	29 U	20 U	77 U
Endosulfan Sulfate	0.10 U	0.10 U	0.10 U	0.10 U	0.10 U	28 U	35 U	33 U	29 U	20 U	77 U
4,4'-DDT	0.10 U	0.10 U	0.10 U	0.10 U	0.10 U	28 U	35 U	33 U	29 U	20 U	77 U
Methoxychlor	0.50 U	0.50 U	0.50 U	0.50 U	0.50 U	140 U	170 U	170 U	140 U	100 U	380 U
Endrin Ketone	0.10 U	0.10 U	0.10 U	0.10 U	0.10 U	28 U	35 U	33 U	29 U	20 U	77 U
alpha-Chlordane	0.50 U	0.50 U	0.50 U	0.50 U	0.50 U	140 U	170 U	170 U	140 U	100 U	380 U
gamma-Chlordane	0.50 U	0.50 U	0.50 U	0.50 U	0.50 U	140 U	170 U	170 U	140 U	100 U	380 U
Toxaphene	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	280 U	350 U	330 U	290 U	200 U	770 U
Aroclor-1016	0.50 U	0.50 U	0.50 U	0.50 U	0.50 U	140 U	170 U	170 U	140 U	100 U	380 U
Aroclor-1221	0.50 U	0.50 U	0.50 U	0.50 U	0.50 U	140 U	170 U	170 U	140 U	100 U	380 U
Aroclor-1232	0.50 U	0.50 U	0.50 U	0.50 U	0.50 U	140 U	170 U	170 U	140 U	100 U	380 U
Aroclor-1242	0.50 U	0.50 U	0.50 U	0.50 U	2.2	140 U	170 U	170 U	140 U	100 U	380 U
Aroclor-1248	0.50 U	0.50 U	0.50 U	0.50 U	0.50 U	140 U	170 U	170 U	140 U	100 U	380 U
Aroclor-1254	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	280 U	350 U	330 U	290 U	200 U	770 U
Aroclor-1260	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	280 U	350 U	330 U	290 U	200 U	770 U

Appendix B (Continued)

Station:	Influent Headworks	Effluent Outfall	Blank	River Mouth	River Old disch	Sediment Site C	Sediment Site A	Sediment Site B	Sediment Mouth	Sediment Old disch	Sludge P pollutant	Sludge EP Tox
Type:	composite	composite	grab AM	grab PM	grab PM	grab PM	grab PM	grab PM	grab PM	grab PM	grab AM	grab AM
Date:	06-27-89	06-27-89	06-26-89	06-28-89	06-28-89	06-28-89	06-28-89	06-28-89	06-28-89	06-28-89	06-27-89	06-27-89
Sample ID #:	268243	268248	268254	268252	268253	268238	268239	268240	268241	268242	268250	268250
Metals	(ug/L)	(ug/L)	(ug/L)	(ug/L)	(ug/L)	(mg/Kg-dry)	(mg/Kg-dry)	(mg/Kg-dry)	(mg/Kg-dry)	(mg/Kg-dry)	(mg/Kg-dry)	(mg/L)
Antimony	1 U	1 U	5 U	5 U	1 U	0.3	0.18 U	0.20 U	0.15 U	0.09 U	5.68	
Arsenic	2	2	1 U	1 U	1 U	8.4	5.7	6.6	2.6	1.01	7.7	0.05 U
Beryllium	1 U	1 U	1 U	1 U	1 U	0.26	0.33	0.30	0.30	0.14	0.43 U	
Cadmium	2 U	2 U	3	2 U	2 U	0.30 U	0.37 U	0.35 U	0.29 U	0.17 U	8.06	0.002 U
Chromium	12	5 U	5 U	5 U	5 U	17.1	21.3	20.4	15.2	11.7	58.8	0.005 U
Copper	181	13	2 U	4	4	38.7	38.9	38.8	29.4	11.7	773	
Lead	46	2	1 U	2	1 U	18.9	16.2	16.8	6.5	4.1	212	0.03 U
Mercury	0.6	0.1 U	0.1 U	0.1 U	0.1	0.14	0.09 U	0.13	0.07 U	0.05 U	4.91	0.0001 U
Nickel	10 U	10 U	10 U	10 U	10 U	12.6	16.4	15.7	11.8	8.5	26.5	
Selenium	1 U	1 U	1 U	5 U	1 U	0.7 U	0.9 U	0.9 U	0.7 U	0.4 U	14.9	0.05 U
Silver	3 U	3 U	3 U	3 U	3 U	0.45 U	0.56 U	0.52 U	0.44 U	0.25 U	82.9	0.003 U
Thallium	1 U	1 U	1 U	1 U	1 U	0.15 U	0.19 U	0.17 U	0.15 U	0.08 U	0.43 U	
Zinc	334	39	5	4 U	5	48.7	48.2	47.5	32:5	21.9	1210	
Barium												0.177

U indicates compound was analyzed for but not detected at the given detection limit

J indicates an estimated value when result is less than specified detection limit

B this flag is used when the analyte is found in the blank as well as the sample. Indicates possible/probable blank contamination

M indicates an estimated value of analyte found and confirmed by analyst but with low spectral match parameters

D indicates the value was from the analysis of a diluted sample

APPENDIX C

CHRONIC BIOASSAY DATA

ERCE Bioassay Laboratory
10477 Roselle St.; Suite C
San Diego, CA 92121
(619) 458-9044 ext. 400

Client Name: EPA X

EBL Test No.: 89175

Sample ID.: Tacoma

Test Dates: 6/30 - 7/6

Fathead Minnow Chronic Toxicity Test Results

Concentrations	Total * Exposed	Total * Survived	Percent Survival	Mean Weight per Fish (mg)
Control	30	28	93.3	0.37
6.25 %	30	28	93.3	0.41
12.5 %	30	30	100	0.36
25.0 %	30	29	96.7	0.40
50.0 %	30	20	66.7	0.36
100 %	30	0	0	N/A

Results Summary

	% Effluent	Comments
NOEC	25.0 %	N/A = not applicable
LOEC	50.0 %	NOEC based upon survival
ChV	35.4 %	
96 hr. LC_{50}	68. %	

SAND DOLLAR SPERM CELL FERTILIZATION BIOASSAY - RAW DATA
WDOE - W.O.# 890224

Conc'n (% v/v)	Rep	Fertilized Eggs	Unfertilized Eggs	Total Eggs	% Unfertilized	Weighted Mean % Unfertilized
Effluent - 268248						
50.0	A	1	99	100	99.0	99.0
	B	2	98	100	98.0	
	C	0	100	100	100.0	
25.0	A	0	100	100	100.0	98.3
	B	0	100	100	100.0	
	C	5	95	100	95.0	
12.5	A	2	98	100	98.0	96.3
	B	3	97	100	97.0	
	C	6	94	100	94.0	
6.0	A	10	90	100	90.0	89.0
	B	8	92	100	92.0	
	C	15	85	100	85.0	
3.0	A	37	63	100	63.0	54.0
	B	52	48	100	48.0	
	C	41	51	100	51.0	
1.0	A	48	52	100	52.0	54.0
	B	51	49	100	49.0	
	C	39	61	100	61.0	
0.1	A	81	19	100	19.0	24.7
	B	76	24	100	24.0	
	C	71	31	100	31.0	
Salinity Checks						
50.0	A	3	97	100	97.0	97.5
	B	2	98	100	98.0	
25.0	A	66	34	100	34.0	32.5
	B	69	31	100	31.0	
12.5	A	78	22	100	22.0	24.5
	B	73	27	100	27.0	
6.0	A	87	13	100	13.0	16.0
	B	81	19	100	19.0	
3.0	A	89	11	100	11.0	13.0
	B	85	15	100	15.0	

Conc'n (% v/v)	Rep	Fertilized Eggs	Unfertilized Eggs	Total Eggs	% Unfertilized	Weighted Mean % Unfertilized
1.0	A	92	8	100	8.0	9.5
	B	89	11	100	11.0	
0.1	A	99	1	100	1.0	4.0
	B	93	7	100	7.0	
Control Seawater	A	81	19	100	19.0	13.7
	B	86	14	100	14.0	
	C	85	15	100	15.0	
	D	87	13	100	13.0	
	E	87	13	100	13.0	
	F	92	8	100	8.0	
Reference Toxicant - Sodium Dodecyl Sulfate (SDS)						
1 ppm	A	79	21	100	21.0	26.6
	B	74	26	100	26.0	
	C	67	33	100	33.0	
10 ppm	A	10	90	100	90.0	91.7
	B	3	97	100	97.0	
	C	12	88	100	88.0	
100 ppm	A	0	100	100	100.0	99.0
	B	2	98	100	98.0	
	C	1	99	100	99.0	

APPENDIX D

GRAIN SIZE ANALYSIS

Appendix D

Sediment Sample		Gravel	Sand	Silt	Clay
Marine-Background	(C)	2	28.1	57.5	14.4
Outfall	(A)	2	12.1	68.5	19.4
Near Outfall	(B)	2	16.2	66.0	17.8
River-Old Discharge	(2)	2	19.6	72.0	8.4
Mouth	(5)	59	40.9	0.0	0.1

APPENDIX E

LABORATORY REVIEW

Laboratory Procedure Review Sheet

Discharger: TACOMA CENTRAL #1

Date:

Discharger representative:

Ecology reviewer:

Instructions

Questionnaire for use reviewing laboratory procedures. Circled numbers indicate work is needed in that area to bring procedures into compliance with approved techniques. References are sited to help give guidance for making improvements. References sited include:

Ecology = Department of Ecology Laboratory User's Manual, December 8, 1986.

SM = APHA-AWWA-WPCF, Standard Methods for the Examination of Water and Wastewater, 16th ed., 1985.

SSM = WPCF, Simplified Laboratory Procedures for Wastewater Examination 3rd ed., 1985.

Sample Collection Review

1. Are grab, hand composite, or automatic composite samples collected for influent and effluent BOD and TSS analysis?

2. If automatic compositor, what type of compositor is used? Manning
   The compositor should have pre and post purge cycles unless it is a flow through type. Check if you are unfamiliar with the type being used.

3. Are composite samples collected based on time or flow? flow - new eff (flow) inf (t.

4. What is the usual day(s) of sample collection? T.W.T 24 hrs

5. What time does sample collection usually begin? 6:30 - 6:30

6. How long does sample collection last? 24 hrs

7. How often are subsamples that make up the composite collected? 20 m

8. What volume is each subsample? 125 ml

9. What is the final volume of sample collected? 2 - 2.5 gal

10. Is the composite cooled during collection? refrig - eff
    r.

11. To what temperature? 5° C
The sample should be maintained at approximately 4 degrees C (SM p41, #5b: SSM p2).

12. How is the sample cooled? mecha. ; ice
Mechanical refrigeration or ice are acceptable. Blue ice or similar products are often inadequate.

13. How often is the temperature measured? – 1/month –
The temperature should be checked at least monthly to assure adequate cooling.

eff. check

14. Are the sampling locations representative? yes - infl.

15. Are any return lines located upstream of the influent sampling location? yes
This should be avoided whenever possible.

16. How is the sample mixed prior to withdrawal of a subsample for analysis? mixed
The sample should be thoroughly mixed.

17. How is the subsample stored prior to analysis? [illegible]
The sample should be refrigerated (4 degrees C) until about 1 hour before analysis, at which time it is allowed to warm to room temperature.

18. What is the cleaning frequency of the collection jugs? every time
The jugs should be thoroughly rinsed after each sample is complete and occasionally be washed with a non-phospate detergent.

soap & hot water

19. How often are the sampler lines cleaned? weekly
Rinsing lines with a chlorine solution every three months or more often where necessary is suggested.

pH Test Review

1. How is the pH measured? probe
A meter should be used. Use of paper or a colorimetric test is inadequate and those procedures are not listed in Standard Methods (SM p429).

2. How often is the meter calibrated? morning before use
The meter should be calibrated every day it is used.

3. What buffers are used for calibration? 7, 4
Two buffers bracketing the pH of the sample being tested should be used.

If the meter can only be calibrated with one buffer, the buffer closest in pH to the sample should be used. A second buffer, which brackets the pH of the sample should be used as a check. If the meter cannot accurately determine the pH of the second buffer, the meter should be repaired.

BOD Test Review

1. What reference is used for the BOD test? Standard Methods
   Standard Methods or the Ecology handout should be used.

2. How often are BODs run? 3 time / week
   The minimum frequency is specified in the permit.

3. How long after sample collection is the test begun? immediate
   The test should begin within ~~24~~ hours of composite sample completion (Ecology Lab Users Manual p42). Starting the test as soon after samples ar complete is desirable.

4. Is distilled or deionized water used for preparing dilution water? dist

5. Is the distilled water made with a copper free still? glass
   Copper stills can leave a copper residual in the water which can be toxic to the test (SSM p36).

6. Are any nitrification inhibitors used in the test? No What?
   2-chloro-6(trichloro methyl) pyridine or Hach Nitrification Inhibitor 2533 may be used only if carbonaceous BODs are being determined (SM p 527, #4g: SSM p 37).

7. Are the 4 nutrient buffers of powder pillows used to make dilution water? buffers
   If the nutrients are used, how much buffer per liter of dilution water are added? 1 ml
   1 mL per liter should be added (SM p527, #5a: SSM p37).

8. How often is the dilution water prepared? daily
   Dilution water should be made for each set of BODs run.

9. Is the dilution water aged prior to use? yes 2 hrs
   Dilution water with nitrification inhibitor can be aged for a week before use (SM p528, #5b).
   Dilution water without inhibitor should not be aged.

10. Have any of the samples been frozen? NO
    If yes, are they seeded?
    Samples that have been frozen should be seeded (SSM p38).

11. Is the pH of all samples between 6.5 and 7.5? Yes
    If no, is the sample pH adjusted?
    The sample pH should be adjusted to between 6.5 and 7.5 with 1N NaOH 1N H2SO4 if 6.5 > pH >7.5 if caustic alkalinity or acidity is present (SM p529, #5e1: SSM p37).
    High pH from lagoons is usually not caustic. Place the sample in the dark to warm up, then check the pH to see if adjustment is necessary.

    If the sample pH is adjusted, is the sample seeded?
    The sample should be seeded to assure adequate microbial activity if the pH is adjusted (SM p528, #5d).

12. Have any of the samples been chlorinated or ozonated? No
If chlorinated are they checked for chlorine residual and dechlorinate‹ as necessary?
How are they dechlorinated?
Samples should be dechlorinated with sodium sulfite (SM p529, #5e2: SSM p38), but dechlorination with sodium thiosulfate is common practice. Sodium thiosufate dechlorination is probably acceptable if the chlorine residual is < 1-2 mg/L.
If chlorinated or ozonated, is the sample seeded?
The sample should be seeded if it was disinfected (SM p528, #5d&5e2: SSM p38).

13. Do any samples have a toxic effect on the BOD test? No
Specific modifications are probably necessary (SM p528, #5d: SSM p37)

14. How are DO concentrations measured?
If with a meter, how is the meter calibrated? both
Air calibration is adequate. Use of a barometer to determine saturation is desirable, although not manditory. Checks using the Winkler method of samples found to have a low DO are desirable to assure that the meter is accurate over the range of measurements being made.

How frequently is the meter calibrated? daily
The meter should be calibrated before use.

15. Is a dilution water blank run? yes
A dilution water blank should always be run for quality assurance (SM p527, #5b: SSM p40, #3).

What is the usual initial DO of the blank? 9.0
The DO should be near saturation; 7.8 mg/L @ 4000 ft, 9.0 mg/L @ sea level (SM p528, #5b). The distilled or deionized water used to make the dilution water may be aged in the dark at ~20 degrees C for a week with a cotton plug in the opening prior to use if low DO or excess blank depletio is a problem .

What is the usual 5 day blank depletion? not much
The depletion should be 0.2 mg/L or less. If the depletion is greate the cause should be found (SM p527-8, #5b: SSM p41, #6).

16. How many dilutions are made for each sample? One
At least two dilutions are recommended. The dilutions should be far enough apart to provide a good extended range (SM p530, #5f: SSM p41).

17. Are dilutions made by the liter method or in the bottle?
Either method is acceptable (SM p530, #5f).

18. How many bottles are made at each dilution? 3
How many bottles are incubated at each dilution?
When determining the DO using a meter only one bottle is necessary. The DO is measured, then the bottle is sealed and incubated (SM p530, #5f
When determining the DO using the Winkler method two bottles are necessary. The initial DO is found of one bottle and the other bottle is sealed and incubated (Ibid.).

19. Is the initial DO of each dilution measured? yes
What is the typical initial DO?
The initial DO of each dilution should be measured. It should approximate saturation (see #14).

20. What is considered the minimum acceptable DO depletion after 5 days? 5.
What is the minimum DO that should be remaining after 5 days?
The depletion should be at least 2.0 mg/L and at least 1.0 mg/L should be left after 5 days (SM p531, #6: SSM p41).

21. Are any samples seeded? eff.
Which?
What is the seed source? Influent (set for 24 hrs)
Primary effluent or settled raw wastewater is the preferred seed. Secondary treated sources can be used for inhibited tests (SM p528, #5d: SSM p41).

How much seed is added to each sample? 3 ml
Adequate seed should be used to cause a BOD uptake of 0.6 to 1.0 mg/L due to seed in the sample (SM p529, #5d).

How is the BOD of the seed determined? seed BOD measurement
Dilutions should be set up to allow the BOD of the seed to be determined just as the BOD of a sample is determined. This is called the seed control (SM p529, #5d: SSM p41).

22. What is the incubator temperature? 20
The incubator should be kept at 20 +/- 1 degree C (SM p531, #5i: SSM p40, #3).

How is incubator temperature monitored? every time BOD run
A thermometer in a water bath should be kept in the incubator on the same shelf as the BODs are incubated.

How frequently is the temperature checked?
The temperature should be checked daily during the test. A temperature log on the incubator door is recommended.

How often must the incubator temperature be adjusted? infrequent
Adjustment should be infrequent. If frequent adjustments (every 2 weeks or more often) are required the incubator should be repaired.

Is the incubator dark during the test period? yes
Assure the switch that turns off the interior light is functioning.

23. Are water seals maintained on the bottles during incubation? yes
Water seals should be maintained to prevent leakage of air during the incubation period (SM p531, #5i: SSM p40, #4).

24. Is the method of calculation correct? Y

Check to assure that no correction is made for any DO depletion in the blank and that the seed correction is made using seed control data.

Standard Method calculations are (SM p531, #6):

for unseeded samples;

$$\text{BOD (mg/L)} = \frac{D1 - D2}{P}$$

for seeded samples;

$$\text{BOD (mg/L)} = \frac{(D1 - D2) - (B1 - B2)f}{P}$$

Where: D1 = DO of the diluted sample before incubation (mg/L)
D2 = DO of diluted sample after incubation period (mg/L)
P = decimal volumetric fraction of sample used
B1 = DO of seed control before incubation (mg/L)
B2 = DO of seed control after incubation (mg/L)

$$f = \frac{\text{amount of seed in bottle D1 (mL)}}{\text{amount of seed in bottle B1 (mL)}}$$

Total Suspended Solids Test Review

Preparation

1. What reference is used for the TSS test? SM

2. What type of filter paper is used?
Std. Mthds. approved papers are: Whatman 934AH (Reeve Angel), Gelman A/E, and Millipore AP-40 (SM p95,footnote: ~~SSM p23~~)

3. What is the drying oven temperature? 103
The temperature should be 103-105 degrees C (SM p96, #3a: SSM p23).

4. Are any volatile suspended solids tests run? no
If yes--What is the muffle furnance temperature?
The temperature should be 550+/- 50 degrees C (SM p98, #3: SSM p23).

5. What type of filtering ~~apparatus is~~ used?
Gooch crucibles or a membrane filter apparatus should be used (SM p95, #2b: SSM p23).

6. How are the filters pre-washed prior to use? yes / distilled w
The filters should be rinsed 3 times with distilled water (SM p23, #2: SSM p23, #2).

Are the rough or smooth sides of the filters up? rough side
The rough side should be up (SM p96, #3a: SSM p23, #1)

How long are the filters dried? 24 hr
The filters should be dried for at least one hour in the oven. An additional 20 minutes of drying in the furnance is required if volatile solids are to be tested (Ibid).

How are the filters stored prior to use? dessicator
The filters should be stored in a dessicator (Ibid).

7. How is the effectiveness of the dessicant checked? yes
All or a portion of the dessicant should have an indicator to assure effectiveness.

Test Procedure

8. In what is the test volume of sample measured? cyl
The sample should be measured with a wide tipped pipette or a graduate cylinder.

9. Is the filter seated with distilled water? yes
The filter should be seated with distilled water prior to the test to avoid leakage along the filter sides (SM p97, #3c).

10. Is the entire measured volume always filtered? Yes
The entire volume should always be filtered to allow the measuring vessel to be properly rinsed (SM p97, #3c: SSM p24, #4).

11. What are the average and minimum volumes filtered?

	Volume		
	~~Minimum~~	Range	Average
Influent	100	—	250
Effluent	500	—	1000

12. How long does it take to filter the samples?

	Time
Influent	
Effluent	1 minute

13. How long is filtering attempted before deciding that a filter is clogged? Start over
Prolonged filtering can cause high results due to dissolved solids being caught in the filter (SM p96, #1b). We usually advise a five minute filtering maximum.

14. What do you do when a filter becomes clogged? start over
The filter should be discarded and a smaller volume of sample should used with a new filter.

15. How are the filter funnel and measuring device rinsed onto the filte: following sample addition? 3 times OK
Rinse 3x's with approximately 10 mLs of distilled water each time (? ?).

16. How long is the sample dried?
The sample should be dried at least one hour for the TSS test and 20 minutes for the volatile test (SM p97, #3c; p98, #3: SSM p24, #4). Excessive drying times (such as ~~overnight)~~ should be avoided.

17. Is the filter thoroughly cooled in a dessicator prior to weighing?
The filter must be cooled to avoid drafts due to thermal differences when weighing (SM p97, #3c: SSM p97 #3c). 1-1½ hrs

18. How frequently is the drying cycle repeated to assure constant filte weight has ben reached (weight loss <0.5 mg or 4%, whichever is less: SM p97, #3c)?
Once a month
We recommend that this be done at least once every 2 months.

19. Do calculations appear reasonable?
Standard Methods calculation (SM p97, #3c).

$$\text{mg/L TSS} = \frac{(A - B) \times 1000}{\text{sample volume (mL)}}$$

where: A= weight of filter + dried residue (mg)
B= weight of filter (mg)

do QA/QC on SS

Fecal Coliform Test Review

1. Is the Membrane Filtration (MF) or Most Probable Number (MPN) technique used?
   This review is for the MF technique.

2. Are sterile techniques used?

3. How is equipment sterilizated?
   Items should be either purchased sterilized or be sterilized. Steam sterilization, 121 degrees C for 15 to 30 minutes (15 psi); dry heat, 1-2 hours at 170 degrees C; or ultraviolet light for 2-3 minutes can be used. See Standard Methods for instruclions for specific items (SSM p67-68).

4. How is sterilization preserved prior to item use?
   Wrapping the items in kraft paper or foil before they are sterilized protects them from contamination (Ibid.).

5. How are the following items sterilized?

	Purchased Sterile	Sterilized at Plant
Collection bottles		✓
Phosphate buffer	✓	
Media	✓	
Media pads	✓	
Petri dishes	✓	
Filter apparatus		✓
Filters	✓	
Pipettes	✓	
Measuring cylinder		✓
Used petri dishes		

6. How are samples dechlorinated at the time of collection? thio
   Sodium thiosulfate (1 mL of 1% solution per 120 mLs (4 ounces) of sample to be collected) should be added to the collection bottle prior to sterilization (SM p856, #2: SSM p68, sampling).

7. Is phosphate buffer made specifically for this test? yes
   Use phosphate buffer made specifically for this test. The phosphate buffer for the BOD test should not be used for the coliform test (SM p855, #12: SSM p66).

8. What kind of media is used? millipore
   M-FC media should be used (SM p896, SSM p66).

9. Is the media mixed or purchased in ampoules? ampoules
   Ampoules are less expensive and more convient for under 50 tests per day (SSM p65, bottom).

10. How is the media stored? refrigerator
    The media should be refrigerated (SM p897, #1a: SSM p66, #5).

11. How long is the media stored? check exp. date
Mixed media should be stored no longer than 96 hours (SM p897, #1a: SSM p66, #5). Ampoules will usually keep from 3-6 months -- read ampoule directions for specific instructions.

12. Is the work bench disinfected before and after testing? yes
This is a necessary sanitazation procedure (SM p831, #1f).

13. Are forceps dipped in alcohol and flamed prior to use? yes
Dipping in alcohol and flaming are necessary to sterilize the forceps (SM p889, #1: SSM p73, #4).

14. Is sample bottle thoroughly shaken before the test volume is removed? The sample should be mixed thoroughly (SSM p73, #5). yes

15. Are special procedures followed when less than 20 mLs of sample is to be filtered? 10 # 20 ml
10-30 mLs of sterile phosphate buffer should be put on the filter. Tr sample should be put into the buffer water and swirled, then the vacuum should be turned on. More even organism distribution is attained using th: technique (SM p890, #5a: SSM P73, #5).

16. Are special procedures followed when less than 1 mL of sample is to b filtered? no
Sample dilution is necessary prior to filtration when <1 mL is to be tested (SM p864, #2c: SSM p69).

17. Is the filter apparatus rinsed with phosphate buffer after sample filtration? yes
Three 20-30 mL rinses of the filter apparatus are recommended (SM p89 #5b: SSM p75, #7).

18. How soon after sample filtration is incubation begun? usually
Incubation should begin within 20-30 minutes (SM p897, #2d: SSM p77, #10 note).

19. What is the incubation temperature? 44.5 - log -
44.5 +/- 0.2 degrees C (SM p897, #2d: SSM p75, #9).

20. How long are the filters incubated? 24 hrs
24 +/- 2 hours (Ibid.).

21. How soon after incubation is complete are the plate counts made? imme
The counts should be made within 20 minutes after incubation is complete to avoid colony color fading (SSM p77, FC).

22. What color colonies are counted? blue
The fecal coliform colonies vary from light to dark blue (SM p897, #2 SSM p78).

23. What magnification is used for counting? dissector scope
10-15 power magnification is recommended (SM p898, #2e: SSM p78).

24. How many colonies blue colonies are usually counted on a plate? 20-40
Valid plate counts are between 20 and 60 colonies (SM p897, #2a: SSM p78).

25. How many total colonies are usually on a plate? 30-50
The plate should have <200 total colonies to avoid inhabition due to crowding (SM p893, #6a: SSM p63, top).

26. When calculating results, how are plates with <20 or >60 colonies considered when plates exist with between 20 and 60 colonies? –
In this case the plates with <20 or >60 colonies should not be used fo calculations (SM p898, #3: SSM p78, C&R).

27. When calculating results how are results expressed if all plates have < 20 or > 60 colonies?
Results should be identified as estimated. yes
The exception is when water quality is good and <20 colonies grow. In this case the lower limit can be ignored (SM p893, #6a: SSM p78, C&R).

28. How are results calculated?
Standard Methods procedure is (SM p893, #6a: SSM p79):

$$\text{Fecal coliforms/100 mL} = \frac{\text{\# of fecal coliform colonies counted}}{\text{sample size (mL)}} \times 100$$